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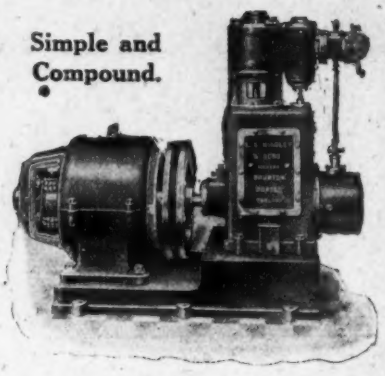

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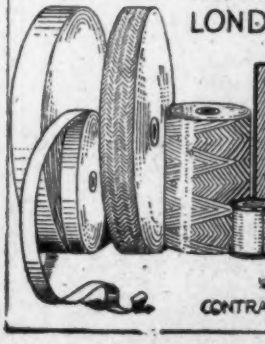

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NATIONAL EDUCATION.

IT is universally admitted that one of the most important of the many problems that are pressing for solution, in connection with the maintenance of the prosperity of this country after the war, and its speedy liberation from the immense burden of debt that is accumulating at such a terrific rate, is the drastic reform of our system of national education. This is a matter which affects our industrial future at least as intimately as any other sphere of national interest, and we are very glad to see that this fact is fully appreciated by so influential a body as the Federation of British Industries, which has recently issued a memorandum, drawn up by the Education Committee of the Federation, on the scheme put forward by the President of the Board of Education. We are informed that the memorandum has received the support of over 2,000 firms engaged in industry throughout the country, a fact which justifies the claim that it is the first authoritative pronouncement of industry upon Mr. Fisher's proposals.

The Committee emphasises the urgency of the question, and in order to secure tangible results as quickly as possible, it has wisely refrained from advocating unattainable ideals at the moment; the greatest stress is laid on the most pressing reforms, namely, the improvement of elementary education, and the provision of a full secondary education for the more able children. The Committee heartily supports Mr. Fisher's proposal to establish compulsory education for all up to the age of 14 years, but cannot accept his further proposal to impose compulsory part-time education on all children up to the age of 18, which, it is feared, would cause a very serious dislocation in many trades at a time when smooth working is of the utmost importance. As regards Mr. Fisher's views on secondary education in general, however, the Committee is in agreement with him, and endorses the principle that every child in the country, of whatever class, should have an opportunity of complete education if it is able to profit thereby.

Instead, therefore, of universal compulsory part-time continuation education, the Committee advocates a liberal system of whole-time education for selected children. Obviously, it is vastly more important that the brighter intellects should be singled out for higher training than that an attempt should be made to bring all and sundry up to a modest level of mediocrity; by the former plan efficiency can be attained on scientific lines, and the great objection to any system which treats all alike, namely, that the clever pupils are kept back by the necessity of waiting for the dull ones, surely the most deadening and discouraging of all restraints, can be avoided. At the same time, the teaching staff, which is numerically far short of the require-

ments, and is likely to remain so, will be more efficiently employed, and will go further towards fulfilling the demands, as a teacher can deal effectively with a much larger class of intelligent pupils than of mixed good and bad.

In this connection the Committee warmly commends the system of whole-time education for selected children which has been adopted by the London County Council, and which is credited with "very excellent results." On the other hand, the Committee is not hostile to the adoption of compulsory part-time education for the children who are not selected for the full-time course, provided that the greatest care is taken to introduce it by degrees, and with full regard to local conditions. The importance of improved physical training is also recognised in the Memorandum. There can be few of our readers, we should think, who have not noticed the extraordinary improvement which is effected in the physique of the average young man by a few months' training for the Army or the Navy, and there is no reason whatever why this most desirable advantage should not be available to our youth in peace-time also. For many years we have held that, apart altogether from the military aspect of the matter, the adoption of a limited system of compulsory universal service would be of priceless value in developing the physical characteristics of the nation's youth, besides imbuing it with the qualities of patriotism and discipline.

In addition to the provision of sound elementary education for all, and of secondary education for a selected number of really able children, the Memorandum contemplates the adoption of means to enable the best of the latter to proceed to a still higher plane of training at the university or technical college, thus affording to every child, of whatever station in life, an equal opportunity of developing his latent talents and equipping himself with the highest resources of scientific and technical progress, a principle which cannot be too cordially endorsed. Here one necessarily must have regard to the fact that many parents of highly-gifted children cannot afford to forgo the earning power of their progeny, with the result that only too often a promising career is cut short by the withdrawal of the child from the educational course along which he is advancing. To meet this objection the Committee offers the drastic expedient of subsidising the parent, in addition to defraying the whole of the cost of education, in cases where the need is met with. While this method must entail a considerable increase in the expenditure, it cannot be doubted that the community would eventually reap a rich return from the investment.

We are glad to note that the Committee realises the absolute necessity of raising the standard of quality, as well as the numbers, in the teaching profession. So long as teaching remains the most ill-paid of skilled occupations, as well as one of the most arduous and unattractive, it is utterly useless to hope for material progress. The multiplicity of educational authorities, largely due to the rivalry of religious denominations, but also arising out of excessive sub-division of control, is another matter referred to in the Memorandum as calling for investigation and reform. Lastly, the Committee emphasises the importance of interesting employers in educational questions, and securing their financial support, to which about 90 per cent. of those who have been consulted have agreed.

The Memorandum is in all respects a most useful contribution to the study of the subject with which it deals; it follows to some extent on the lines of previous reports, but, without going into excessive detail, it appears to adopt a broader view, and to secure a better grasp of the existing situation and its needs, while its origin, and its foundation on the basis of the views of so many industrial firms, lend weight to its proposals. No doubt it will receive the close attention of the Ministry of Education, and of the Central Organisation that was formed at the conference of engineers last autumn.

Our Trade Commissioners.

In connection with the important measures that have been adopted by the Government for greatly extended assistance to be accorded to industry through the instrumentality of 16, instead of four, Trade Commissioners, an announcement has been made this week indicating a number of the appointments that have been made. It was a foregone conclusion that the four experienced officials who in recent years have been serving us so well in a similar capacity should remain and continue their good work, though not in every case in the scene of their present labours. We believe that the selection of Mr. C. Hamilton Wickes to remain attached to the headquarters at the Department of Overseas Trade (Development and Intelligence) will evoke expressions of general satisfaction. Mr. Wickes had had a wide general connection with commercial affairs in this country for years before he went out to represent our interests in Australia, and he followed his Australian experience with several years in the vast Canadian field. He is, therefore, thoroughly familiar with two of our most important markets where after-the-war trade developments should be of enormous importance for us at home, but his knowledge is not limited even to this wide ground, for we suppose there is hardly a Government official who during the last few years has been brought into more direct touch with our manufacturers and their products in the great industrial and commercial centres of the United Kingdom. As our readers are aware, he has the added merit of knowing many aspects of electrical industrial questions as a result of personal investigation. All of these things taken together render him, in our opinion, pre-eminently suited to fill the office indicated above in London during the present more or less critical period of organisation and re-organisation.

The Canadian territory is so vast that it can hardly be efficiently covered for present-day trade purposes by one Commissioner. In a short time Mr. G. T. Milne, who has latterly been acting in Australia, is to transfer his services to Canada, and will act as Senior Trade Commissioner, with headquarters at Montreal. Mr. W. G. Wickham and Mr. R. W. Dalton will both continue to serve in their present capacities in South Africa and New Zealand respectively, but Mr. S. W. B. McGregor is announced to follow Mr. Milne at Melbourne "shortly." He will be a "Senior" Commissioner, as will Mr. Milne in Canada. As recent announcements have indicated, India is to be attended to in future, and in this connection Mr. T. M. Ainscough, O.B.E., who has been entrusted with foreign trade missions in the past, shortly proceeds to Calcutta to become "Senior" for India. Two new appointments are these: Mr. F. W. Field, who is now Imperial Trade Correspondent at Toronto, will become a Trade Commissioner at the same place, and Mr. L. J. Wilson Goode will serve as Acting Trade Commissioner in South Africa while Mr. Wickham is at home on an official visit. We thus have the names of one-half of the men who are to be our 16 Commissioners, assuming that Mr. Hamilton Wickes continues to act under that title. In the main, the appointments represent the strengthening of the service by establishing more substantially and satisfactorily the positions of the men of tried experience. We shall await with interest the remaining eight appointments, which may bring into the service men who will command respect at any rate equal from the industrial and commercial world.

THE SELECTION OF AN ELECTRICITY METER.

By W. G. N.

Electricity meters are usually bought in quantities on period contract terms. This makes a right choice particularly desirable, because of the large numbers of meters involved, the long period which must elapse before any desired change can be made, and, for reasons of standardisation, the disadvantage of frequent changes.

Doubtless every meter man has his favourite meter, and could give reasons for his preference, but probably few have gone to the trouble of accurately "placing" in order of merit the various meters submitted for their examination from time to time.

A comprehensive method by which different meters may be "placed" is hereinafter described. Some such method is necessary if the purchaser is to be certain that the meter chosen is the most suitable.

By carrying out an investigation on the lines indicated, and giving position marks to each meter for every qualification, final totals can be obtained which will settle the question without gainsay. Thus, if six meters are being considered, the maximum number of marks for each qualification will be six, if there are five meters, the maximum will be five, and so on. The relative importance of each qualification may, of course, vary with circumstances. If a certain qualification is regarded as more important than others, the position marks of each meter may be multiplied be a suitable factor for this particular qualification. The meter which obtains the greatest total number of marks will be the best meter.

The qualifications of a meter fall under two main heads—namely, Quality and Cost. There are certain other considerations relating to the Commercial Service given by different manufacturers.

Quality.

The Quality of a meter may be considered under three sub-divisions—viz., Accuracy, Finish, and Convenience.

Accuracy is undoubtedly the most essential qualification of a meter, and it assumes its true proportions when it is remembered that an improvement of 1 per cent. in the accuracy of the meters may result in the collection of additional revenue equivalent to a saving of 10 per cent. in the coal consumption.

A meter which is not reasonably accurate belies its name; but in comparing the accuracy of meters it should be remembered that not only should the initial accuracy be considered, but also the accuracy after service.

Most supply authorities have facilities for testing the initial accuracy of samples submitted, but to estimate the ultimate accuracy requires sound judgment, based on the design of the meter and the evidence furnished by the maker.

Initial Accuracy.—To test the initial accuracy thoroughly, variation of registration should be noted with—

For continuous current meters.	For alternating current meters.
Variations of load	Variations of load.
,, ,, voltage.	,, ,, voltage.
,, ,, temperature.	,, ,, temperature.
	,, ,, frequency.
	,, ,, power factor.
	,, ,, balance of load (if polyphase).

Tests should also be made to ascertain the starting current, to see how the meter is affected by external magnetic fields, and, in the case of meters with shunt windings, to see if there is any tendency to run on shunt.

An insulation test and a test for overload capacity may also be desirable, although it will probably be satisfactory to take the maker's guarantee for these.

A thorough test for initial accuracy not only reveals the qualities of the electrical design of the meter, but helps to show up any defects of workmanship causing undue friction.

Accuracy after service will depend on the quality of the materials, the stability of the mechanical design, and the type of meter.

Quality of Materials.—The permanence of the braking magnets is specially important, for if these are not properly aged before calibration, their strength will vary, and the registration of the meter will thus be rendered inaccurate.

The jewels and pivots should be the best obtainable. The jewels should be fixed in settings easily adjustable, and the jewels and pivots should be easily removed.

The insulation of the coils and other live parts should be examined, and any insulating material used should not warp or swell in damp or soften with reasonable rise in temperature.

Spindles and other metal parts should not be liable to rust or corrode.

Stability of Mechanical Design.—The main supporting frame and case should be of material that does not shrink or warp, and it should be sufficiently robust to stand the jarring incurred during transit without upsetting the calibration of the meter.

A clamping device for supporting the rotor independently of the bearings during transit is an advantage.

The holes for the fixing bolts or screws should be large enough to admit a bolt or screw capable of withstanding any strain that is likely to be incurred. This may be considerable in the case of meters of large capacity, owing to the size of the cables which have to be connected to the meter.

Type of Meter.—A rough comparison of the probable durability of the jewels and pivots may be made by noting the speed in revolutions per minute and the weight of the rotor. The meter which has the lightest rotor running at the lowest speed will probably show the least wear on the jewels and pivots. With a mercury meter the rotor floats in the mercury, and the pressure between the pivots and the jewels is, therefore, very slight.

Accuracy after service also depends on the constancy of the retardation due to friction. In alternating-current meters of the induction type this is not likely to vary much, as the rotor is very light and the speed low, so that wear between pivots and jewels is negligible. The same remarks apply still more to continuous-current meters of the mercury motor type.

But in the case of commutator meters, in addition to the greater wear of jewels and pivots, due to heavier rotors and higher speeds, the variation of the friction between the brushes and the commutator may quite change the calibration of the meter.

Finish is deserving of some notice, for this may be in effect a gauge of the quality of the workmanship employed. It should be remembered, however, that "finish," like "charity," may cover "a multitude of sins"; in other words, a well finished meter is not necessarily an accurate one.

Convenience.—This may be considered as referring to handling, fixing, sealing and reading.

Handling.—Heavy meters are not so easily handled as light ones, but a heavy meter with a carrying handle is more easily handled than a light one without a handle.

Fixing.—Three fixing holes are more convenient than two or four, for the meter can be hung by the top screw and levelled up before the other screws are inserted. Room should be allowed for fixing the screws without the use of special tools.

Sealing should be easily effected, and the seal should be in a prominent position, so that any tampering is at once noticed.

Reading.—Clear open dials are the best, and it is preferable to have all the figures in a straight line. They should be easily read, even in a bad light. Dials easily read are an advantage; directly, by enabling the meter readers quickly to take accurate readings, and, indirectly, by making

it easy for the consumer to read his meter, and thus overcome the sense of mystery which inspires distrust.

Cost.

The question of cost may also be considered under three sub-divisions—namely, Prime Cost, Running Cost, and Maintenance Cost, and a final decision on the question of cost should only be arrived at after an investigation has been made under each sub-division.

The *Prime Cost* does not require any other remarks than a reminder that the tenders should be carefully read to see whether the makers' offers all agree with the specification as to size, type, &c. Makers are often informed by customers that they are "hopelessly out" in price when in reality the customer is comparing a more expensive with a less expensive size or type.

The *Running Cost* is important, and may determine the type of meter to be used. Thus where the voltage of a continuous-current system is constant within narrow limits, ampere-hour meters can be used with advantage, and the shunt losses which would be incurred with watt-hour meters are thus avoided. On continuous-current systems there are very few cases where the use of watt-hour meters can be shown to be preferable.

Shunt losses should be capitalised, for with many small consumers the energy consumed by the meter is an appreciable percentage of the total energy taken. On the other hand, it should be remembered that shunt losses, being continuous, are supplied at a load factor of 100 per cent., and their cost should be reckoned at a reduced rate to correspond.

Maintenance Cost.—Under this heading may be considered the ease or difficulty experienced in carrying out minor repairs on site or in the customer's test room, and the facilities offered by the maker for the supply of spare parts.

The first of these considerations depends largely on the design of the meter and its suitability for dismantling and reassembling by junior assistance. The maker's method of manufacture affects this question, for parts are more easily interchanged if made by machinery to jig and template than if made by hand.

The second has to do not only with the immediate future but is also affected by the maker's willingness to maintain a stock of spare parts for a reasonable period after the meter has been superseded by a new design.

Commercial Service.

This covers such questions as delivery, the facilities offered by the maker for checking meters supplied by him, guarantees, and last, but not least, courtesy.

Delivery is sometimes the question which decides the placing of an order. Customers are advised to consider not only the promise of the maker but also his past record for keeping to the promises made.

Facilities for Checking Meters on Site.—Some makers send their representatives periodically to large customers to test and adjust in the customers' test rooms meters which cannot be conveniently dealt with by the customers' own meter men. This practice is of great mutual advantage in avoiding delays which would otherwise occur in sending meters back to the maker's works, and in enabling the maker to keep on good terms with his customers.

Guarantees.—To hold a maker to the literal terms of his guarantees may be difficult, but old-established firms who value their goodwill are generally prepared to stand by their goods, even if they do not consider that they are legally bound to do so.

Courtesy.—Lack of courtesy in business dealings, strictly speaking, should not influence the choice of a meter, but human nature must be considered, and unintentional lack of courtesy is often the cause of loss of business. Buyers of meters should remember that polite correspondence will not affect the meter accuracy, and correspondents should remember the wise man's estimate of a "word fitly spoken." Sometimes it is more fitly left unspoken.

The foregoing considerations are here summarised in chart form, and it is hoped that a reference to the chart may occasionally be helpful when tenders are being considered by purchasers of electricity meters:—

THE SELECTION OF AN ELECTRICITY METER.

Choice should be guided by—

- Quality denoted by
  - Accuracy viz.:—
    - Initial accuracy depending on
      - Electrical design affecting
        - Errors due to variation of: Load. Voltage. Temperature. Frequency. Power factor. Balance of load.
        - Starting current.
        - External magnetism.
        - Shunt running.
        - Insulation resistance.
        - Overload capacity.
      - Workmanship affecting: Friction.
    - Accuracy after service depending on: Durability of materials, jewels, &c. Stability of adjustments, general robustness, &c.
  - Finish. Type.
  - Convenience as regards: Handling. Fixing. Sealing. Reading.
- Cost: Prime. Running. Maintenance.
- Commercial service: Delivery. Facilities for examination and repair on customers' premises. Guarantees. Courtesy.

ELECTRIC SIGNALLING AND CONTROL ON RAILWAYS.

OWING to the absence of the author, Mr. C. M. JACOBS, this paper before the INSTITUTION OF ELECTRICAL ENGINEERS (an abstract of which appeared in our last issue) was read by Mr. J. SAYERS.

Col. PRINGLE, in opening the discussion, said it was not too soon to formulate plans for railway development after the war. He hoped more extended experiments would be made with the three-position signal; it was desirable to use the upper quadrant and orange coloured light. In track circuiting reliability was of the first importance, and if some method for standardising could be devised it would be a good thing. As regarded train control, the Great Western system was excellent. Such a system should obviate the majority of accidents which were due to signalmen and enginemen; it must not be of a type which tended to neglect of observation of the road, and for this reason cab signalling was less favoured, and audible signals with direct action on the brakes were now being tried. A large proportion of accidents was due to misreading the home or starting signals, and if the control only dealt with the distant signals, it only covered half the cases. The effect of the control at distant and stop signals should differ in degree; at the latter it was necessary to bring the train to a standstill, and he felt that it would not in such a case be inadvisable to take the control out of the hands of a driver. He understood that on the Underground and Tube Railways this system had had no ill-effect on the drivers.

Mr. ROGER SMITH, thought the author's remarks on the position of the ramp in train control systems were rather ambiguous. Neither direct nor alternating current necessarily required the use of a fourth rail in the centre of the track. It was possible that direct-current of moderately high pressure would be used here in future, with the running rails as a return. In such a case, if alternating current was necessary for the track circuit, he asked whether the cab-signalling installation shown in the paper had been adopted yet for the use of alternating current on the ramp. If the national scheme of electric supply, now being considered, were adapted, much more alternating current would be available in the future, and he recommended signal engineers to consider its more extended use. Higher voltages for track circuits could not readily be supplied, except from public mains. At present batteries had to be depended on in country districts. Many thousands of secondary cells were re-charged last year by the Great Western Co., although track circuiting was sparingly used on that line. A light battery, which would remain on open circuit for the longest possible time, was needed.

Mr. HURST considered that the three-position signal shown left some opportunity for misreading the indications, although this could be avoided by suitable design. It required consideration; in America that type was used in very open country, but in this country it was difficult to arrange signals at junctions to give easy vision. Orange lights had been practically given

up by the Clearing House, as it was found to be the worst colour for colour-blindness, and a very large number of men could not see it. He was glad the author rather condemned the use of a common conductor. He (the speaker) had charge of the first automatic signalling on the North-Eastern line, where there was a common wire, and they were always getting false indications. The trouble was avoided by cutting the line into sections, and through complicated junctions by using a single wire for up and for down lines. The use of independent batteries tended to avoid wrong signals through faults, which a central-battery system was open to. Automatic-control apparatus was about the best thing that could be devised, because it could be fitted to any class of locomotive; he thought the Underground Railway train-stop was not so applicable to mineral and goods trains. There was always the difficulty that apparatus in the permanent way might be removed; a mislaid sleeper had knocked off the engine apparatus, and in one case a driver ran 60 miles without knowing that anything was wrong.

Mr. W. J. THORROWGOOD said the upper quadrant signal was not universal in America, and only 17 per cent. of the mileage was protected by automatic signals. Daylight varicolour signals were also employed, which were electrically illuminated by the signal apparatus; there were also position-lamp signals employing white lights in different positions; a hood over the lamp shaded it from the sun. Before they swept away our almost universal lower quadrant system, they should consider all the alternatives. Many thousands of signal repeaters were satisfactorily used on the South-Western Railway; he saw no difficulty in using common conductors for signalling purposes under suitable conditions, and mentioned that a common positive conductor had been in use at Clapham Junction for years. He agreed that the shunt resistance usually employed could be very much higher, but considered that a battery pressure of 18 volts for a single-track circuit was rather high; with a 4.5-ohm relay and battery E.M.F. of 1 volt, it was possible with suitable regulating resistance to obtain a maximum shunt resistance day a broader interpretation must be accepted.

Mr. GOTT was surprised to hear that such small pressure differences were used in electric track circuits.

Mr. LAST said his experience in railway working led to the conclusion that the greater the simplicity, the greater the efficiency. Electric control in all its aspects was too complicated, and it would be disastrous to take away the responsibility of the signalman or driver. The ordinary mechanical signal system was so simple that nothing could go wrong, the only fault being an uncertain indication in hot weather, due to wire stretching.

Mr. PROUD pointed out that the paper must not be regarded as suggesting that track circuits were at present unreliable; it had been shown that the 4.5-ohm relay would give the shunt recommended by the author.

NOTES ON WELDING SYSTEMS.

BY CAPT. JAMES CALDWELL, M.I.E.E., R.E.

(*Abstract of paper read before the* INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND, *January 22nd*, 1918.)

WELDING strictly is the art of uniting parts of similar metal by pressure at a temperature short of the fusing point. Today a broader interpretation must be accepted.

The very modern extension of the term welding to other than the ferrous metals includes processes which are in the nature of autogenous soldering, and it is very difficult now to draw the line between welding in the old and strict sense of the term and autogenous soldering.

As applied to the ferrous metals, some of the modern processes about to be described involve the addition of metal which is fused into the junction, and would be more strictly described at autogenous soldering than welding. Practically the distinction has disappeared.

Pure Smith Welding.—This, the original method, the only one practical until recently, and then only on wrought iron and steel, consists in heating the parts to a temperature at which they are plastic, bringing together the surfaces to be united, and applying pressure by hammering or equivalent means. It depends upon the fact that clean surfaces of those metals unite under pressure at a correct temperature, and that there is a sufficient range of temperature during which they remain in a welding condition to permit of the necessary manipulation, and that the oxide formed by heating fuses at the welding temperature. The principal points to be observed are that the surfaces to be united shall be clean, the temperature within a certain range, and the hammering so applied as to bring the whole of the surfaces into intimate contact.

The cleanliness of the surface is secured by putting thereon some substance which will fuse, thus protecting the metal from oxidation, and uniting with any oxide formed into a fluid slag or flux, which is expelled under the hammering, leaving the cleaned surfaces free to unite.

In the case of cast iron and certain steels the welding temperature range is much restricted, mainly because the metal becomes damaged, or melts by a comparatively small increase of temperature beyond the minimum required for welding.

Good welding is dependent upon the skill and conscientiousness of the operator, and even a good operator cannot be certain that every weld he makes is a good one. These facts, and the necessity for bringing the parts to be united to the forge fire, restrict smithy welding to comparatively simple shapes, and to articles of comparatively small cross-section.

Resistance Welding is a form of electric welding which is the closest approach to the original smith welding. The surfaces to be united are approximately fitted, brought into close contact, and an electric current passed of sufficient strength to bring the surfaces to welding heat. Then pressure is applied to force them into contact and to extrude oxide, &c., as far as possible. The heat produced by the passage of the current is greater at the contact surfaces than in the solid metal, because the electric resistance, even of well-fitted surfaces, is much greater than that of a similar length of solid metal. The heat is therefore localised by this fact, and is further localised by using clamping electrodes of low resistance, which hold the work as nearly as possible to the weld. Owing to the rapidity of the heating, and the very small amount of air between the opposed surfaces, very little oxidisation can occur.

Butt Welding is applicable to the welding of rods, bars, &c., transverse to the length of the pieces. The pieces to be united are brought together end on, held in proper clamps, the current is switched on, and end pressure applied as soon as the ends are sufficiently heated. The pressure and current are maintained until a distinct burr is formed round the weld, showing that an appreciable amount of plastic flow has taken place, and that there is little likelihood of any oxide which may have been formed remaining in a continuous formation to weaken the weld. This weld is in most cases hammered whilst cooling.

Spot Welding is most commonly adopted in this country to unite sheets or thin plates where a continuous weld or joint is not required. The two sheets are placed between electrode clamps, which press them together; current is then switched on, the surfaces in contact are brought up to welding heat, and the pressure is maintained after current is off until sufficient cooling occurs. The sheets are then moved on to the next spot to be welded, and the operation is repeated. Work so welded is, therefore, united by a line of small welds, and may be compared to flush riveted work. Further developments of this method comprise the uniting of much thicker steel plates, such as constitute the hull of a ship, and experimental work of this nature is now being carried out in America with a view to substituting spot welding for riveting. To make up material displaced under heat and pressure, which might result in perforation with excessive current, snap heads are sometimes applied to the side of the plates, these forming part of the homogeneous weld.

Seam Welding is an extension of spot welding, applicable to comparatively thin sheet work. The electrodes are rollers through which the two sheets are passed, when current is applied and the rollers are revolved. The electric current heats up the sheets to welding point as they pass between the rollers, and they are thus united along the whole of the roller path. This continuous seam joint is stronger than spot welding, is fluid-tight, and the process is comparatively rapid, as it is continuous. The surfaces to be joined must be absolutely clean, either sand-blasted or pickled with acid.

It is common to all resistance welding methods that a comparatively heavy current at a low voltage is required. For this reason alternating current is used, the supply from any available source being stepped down by a transformer, which forms part of the welding apparatus.

Generally, the secondary winding of the transformer consists of a single turn of heavy copper conductor, to the ends of which the clamps or electrodes are secured. In most cases the electrodes are specially cooled by water circulation. This is particularly necessary in butt welding large sections, where the current runs to thousands of amperes, and the welding takes an appreciable time.

Butt welding was first used on a large scale for jointing tramway rails. Among the smaller work for which it is used, the jointing of wire and tubing in manufacture, cable making, and windings of electrical machinery has become very general. The process is also employed in chain making.

The use of both spot and seam welding is most general for comparatively thin sheet articles to be joined by their overlapping surfaces.

Certain pairs of metals can be united by resistance welding, but the welding (or fusion) temperature must overlap or approximate for success.

Fusion Welding.—In the fusion method the edges or surfaces of the pieces to be joined are raised to fusing point. Very generally fused metal is added of composition similar to the work, so that new and old metal are amalgamated to an approximately homogeneous mass. Both flame and electric methods of heating are employed. Fusion welding should properly be classed as autogenous soldering.

Carbon Arc.—Generally known as the Benardos system. The work is connected to the positive lead, and the negative electrode is a carbon rod fixed in an insulated holder. An arc is struck by touching the work with the carbon and withdrawing it to a distance varying with the current used.

The pressure required is about 90 volts, and the current from 50 to 500 amperes, according to the size of the work. The carbons vary from ¼ in. to 1¼ in. in diameter to suit the current. A regulating resistance is used to limit the current, and closer regulation is effected by the worker's control of the length of arc.

The work should be the positive electrode, as that is the hottest part of the arc, and because with the opposite arrangement carbon is carried from the movable electrode to the fixed one, and combines with the fused metal. With the correct connection it is claimed that carbon and other inpurities are removed from the iron.

The temperature of the positive electrode of an electric arc is very high. In the case of carbon, it is estimated at about 7,500 deg. F. In other materials it is limited to the vaporisation or boiling point of the metal operated on. It is not necessary to reach such temperatures in welding; the carbon rod is moved along at the rate necessary to obtain good fusion to the necessary depth.

The light and heat from the arc are extremely prejudicial to the unprotected eyes and skin, so that the operator must be well protected.

The Benardos arc is extensively used for filling blowholes in steel castings. The blowhole surface is fused, and metal added and welded up with the original material. Sound work can be secured with due care.

In making butt joints in iron or steel, the parts are abutted, and pieces of scrap of the same material are added and melted to thicken up the joint. Generally this is swaged whilst still at welding heat, the carbon and the swage being used alternately. Lap joints are made in a similar way, metal being added to level off the angle end of the lap.

The carbon arc is used very successfully in the manufacture of steel oil drums, and has been applied during the last 20 years by the Steel Barrel Co. at Uxbridge. For this class of work the carbon arc seems specially suitable, the thickness of the metal generally, and ease with which the side seam can be supported while welding, preventing the burning of holes in the metal.

When tested to destruction by internal pressure the longitudinal weld stretches circumferentially like the original metal. Analysis of the welded metal show that carbon, phosphorus, and manganese are removed from the mild steel, leaving nearly pure iron.

The process requires skill, care, and experience. Swaging and annealing are important items, and for work where these cannot be applied there are better methods available.

The carbon arc has been used on cast iron, using a cast-iron rod as filling material.

The operator should aim at holding the carbon at a distance which gives a quiet, steady arc. With too short an arc the metal boils and spurts. With too long an arc the arc wanders, the heat developed is partly wasted in the air, and there is a liability to oxidisation of the hot metal. The best length of arc depends upon the current used. Therefore, the current needed must be regulated by the resistance in series, and not by varying the length of arc.

It does not appear that carbon arc welding is in general use for other than ferrous metals, although copper can be welded by this process.

The carbon arc is used for cutting and holing, sometimes with a jet of compressed air or oxygen to assist the process. On electric tramways and railways, where current is available from a trolley or third rail, it is a very convenient way of cutting and holing hard steel "special work," which is not amenable to ordinary tools.

Metal Arc.—In the Slavianoff process, the carbon rod is replaced by a rod of metal of similar composition to that to be welded. The arc temperature with a metal electrode is considerably lower than the carbon arc, so there is less risk of burning the work.

In a carbon arc, the material of the positive electrode is carried across the arc in the form of vapour, and deposited on the negative electrode. It may be more or less oxidised by contact with the air during the passage, therefore, if the rod is made the positive pole, metal from it is projected upon the work. In a metal arc, besides this action, molten portions of the smaller electrode are projected bodily across the arc. This seems to occur independently of the polarity with alternating-current as well as continuous arcs. The point does not seem to have been investigated, but it is established that continuous current, with the rod the positive electrode, is better than alternating current, though both are in successful use. The projection effect is sufficiently powerful to overcome gravity, so that welding can be done from below. The result is that the material of the rod is transferred, and forms the filling metal for the joint. Slavianoff introduced this process, and it was found to be superior in some respects to the carbon arc. There is no possibility of carbon being added to the welded metal. Suitable constituents can be added to the rod to obtain the required quality of metal in the weld, matching that of the work.

The bare-metal electrode has, however, some disadvantages. The electrode is necessarily at a red heat for some distance from the arc, and therefore oxidises on the surface, and the transferred metal is more or less oxidised by contact with the air in its passage across the arc. This oxide is liable to get into the weld, forming flaws. The bare metal also dissipates a good deal of heat, thus wasting energy. On the other hand, the arc itself is much shorter than the carbon arc for equal currents, and less energy is radiated from it.

The bare-metal electrode is used considerably in the United States, where some users state that no fluxing is necessary. Other American authorities state that the weld made without fluxing is distinctly cold and short, and requires annealing. There is very little European experience available as to welding with bare-metal electrodes.

Coated-metal Electrodes.—In the gaseous flux process the metal electrode is covered with a fireproof sleeve of non-conducting material, so that as the metal is removed by the arc the sleeve projects beyond the end of the rod, forming a guide for the molten welding metal, the sleeve itself falling away automatically. This sleeve also protects the metal from oxidisation, and reduces heat losses.

It is an improvement on the bare-metal electrode, and a great deal of satisfactory work has been done with it, namely, in repairing marine boilers, stern frames, and other ship parts. It is also successfully used to build up worn parts, such as propeller shafts, worn crank shafts and axles, which are afterwards machined to size.

The patent claims the use of no particular material for the fireproof sleeve, and no other purposes than those mentioned, but the companies exploiting the process claim that it can be made the vehicle of constituents which will give desired characteristics to the added metal.

Liquid Flux Process.—In this process, invented by Stromenger, of the Quasi-Arc Co., a sleeve or covering is applied to the material, and the material of this sleeve is such that it melts and forms a flux covering the end of the electrode and the added metal, thus protecting both from oxidisation. The flux may contain constituents having a chemical action upon the fused metal to improve its qualities. As originally used, the electrode was laid along the line of the weld, connected to one pole of the circuits, and an arc started at one end which travelled along the line, fusing both the work and the electrode metal, and leaving the weld covered with the flux. It was found better, however, to clamp the rod in a holder, moving it by hand along the length of the weld at a suitable rate, and giving it at the same time a swinging movement across the line of weld, as is done in blowpipe welding. The arc is formed entirely within a sheath of molten flux, so that the metal is at no time exposed to oxidisation. The arc is very short, about ¼ in. as a rule. Incidental advantages of this method include smaller heat losses from the arc, and that work can be done with a lower expenditure of energy than by any other arc methods.

The covering material used generally has asbestos as a basis, which is impregnated with salts, calculated to combine with the asbestos to form a mixed silicate flux or slag of suitable viscosity, and with the property of cleaning the metal surfaces from oxide, &c. The viscosity of the molten slag is of importance. It must be sufficiently fluid to permit the free movement of the rod working in it, and to free itself from the molten metal, but not so fluid that it is blown away from the weld by the gases escaping from the arc. Different makers use different compositions, and it is probable that some variation is desirable to suit different metals.

Some experiments are being made with fluxes of a "basic" character instead of "acid" silicates, presumably to reduce the silicate in the metal.

In some cases the fluxing material is put on the electrode rods in a plastic condition by forcing through dies, and in other makes part of the flux constituents are placed in the form of a powder in a tubular or channel electrode.

The material of the rod can also be varied to suit the work. For example, nickel-plate rods are made for the special purpose of welding high-speed tool steel into mild-steel shanks. Compound rods are made, and an aluminium ribbon or wire is sometimes wrapped round the rod, before the flux coating is applied. Since the fused electrode metal is protected from oxidisation by the flux, it can be so compounded as to give a welding material of any desired composition, which is of considerable importance when the weld has to resist high stresses, or when the added metal has to act as a reinforcement, or has to be machined to form a working part or surface.

There is a great deal of experimental work in process on these lines, and whilst some of the results may have little more than advertising value, others of material importance have already become known.

The fluxed-metal arc process is certainly of the greatest promise for constructional welding, as, for example, in shipbuilding. Trials already made on full scale show that in some respects it is superior to riveting. Actual experience in ships in service is wanted to show whether these last results are borne out in practice, because no testing machine can reproduce the complete stresses endured by a ship in service. There is already good reason to say that if welding can replace riveting, there will be a considerable saving in material and labour in shipbuilding. Whether an all-welded ship is practicable or not, this method of welding is satisfactory for a large number of constructional details.

Butt joints must be suitably prepared by veeing and fitting. Plates under ¾ in. thick need not be veed, as complete fusion for this depth can be assured. The angle of the V should be no larger than to permit the end of the electrode to get well down to the lower surface. In thick work it is usual to apply several layers to get full thickness. The slag should be

removed from each layer before another is applied, and the surface brushed bright with a wire brush.

The rod is held at right angles to the face of the work. Care is necessary to maintain the arc at the proper length. If the electrode touches the work it will probably stick. It should be fed down at the rate at which it melts, or the arc will break from the great length. Excessive length of arc short of the breaking point tends to produce porous metal. The rate of feed along the joint should be steady, so as to produce a layer of even thickness. Interruptions should be avoided, and when unavoidable—as in coming to the end of an electrode—the metal should be thinned out for a short distance and thoroughly re-fused.

(To be concluded.)

LEGAL.

F. D. BALDOCK *v.* THE CITY OF WESTMINSTER COUNCIL AND THE CHARING CROSS, WEST END & CITY ELECTRICITY CO., LTD.—CLAIM FOR DAMAGES.

AT the Lambeth County Court, on Saturday, before Judge Hodges and a jury, Frank Douglas Baldock, taxicab proprietor, of Kennington, brought an action for damages against the City of Westminster Borough Council and the Charing Cross, West End & City Electricity Co., Ltd. The amount in dispute was agreed upon between the parties at £48 15s., the question for the jury to decide being one of liability only.

Mr. H. Brandon appeared for the plaintiff, Mr. Lort Williams for the Council, and Mr. Barrington Ward for the company.

Mr. BRANDON said that on the night of March 20th, 1917, one of plaintiff's drivers was proceeding with a cab down Cockspur Street, Westminster, when he collided with an unlighted refuge in the road. This was soon after eight o'clock at night. It was a very dark night, and was raining. At first the action was brought against the Council, but as the Council had entered into a contract with the company for the lighting of the streets, the latter had been joined as defendants. Where this refuge was situated he should consider one of the most dangerous spots in London. The cab, which had an officer inside, came out of Northumberland Avenue, and passed on the off side of the lavatory in Trafalgar Square. It went into Cockspur Street, where there were two refuges. The first had previously had a light on it, but there was no light on this night, and the cab drove into the standard. There was negligence in not having the refuge lighted either on the part of the Council or their servants, the company. The Council admitted that they were responsible for the maintenance of the standard and the refuge, but were not liable for the lighting of the streets. If the light was out it was their duty to have put up at once a red storm light. A considerable amount of correspondence had passed between the Chief Commissioner of Police and the Home Office and with the Council with regard to the lighting of this particular district, showing that in the opinion of the authorities it was too dark. On the same night shortly before this accident another taxi-driver ran into the same standard with his cab, which was damaged to the extent of £60. At that time there was no light on the refuge. In their defence the company stated that they were going to depend on instructions given under the Defence of the Realm Act that they must keep the lights low, but that did not exonerate them or the Council from leaving unlighted a refuge in a dangerous thoroughfare. He proceeded to read a long correspondence since 1914 between the authorities at Whitehall and the Council as to what had taken place over the lighting of this area.

Mr. WARD objected to the introduction of matters which, he maintained, did not come within a reasonable period of the date of the accident.

Judge HODGES ruled that only evidence could be admitted appertaining to any other accident on that particular day.

Mr. BRANDON added that some time after the second accident a red storm light was placed on the standard.

Evidence having been given, plaintiff's case was closed.

Mr. WARD maintained that there was no evidence of negligence on the part of the company. It was a fact that the electric lamp at this place, which was ordinarily lighted, was out of lighting. Under the powers conferred upon the Home Office under the Defence of the Realm Act, they had had to reduce their lighting, and it was a criminal offence to contravene the orders issued from time to time. Plaintiff found that one lamp was out in a time of great national urgency, but that was not evidence of negligence.

LEONARD JAMES BEIT, assistant surveyor to the Westminster City Council, said he had the supervision of the lighting of the city in his charge under the Defence of the Realm Act. From September, 1914, up to the present time he had been in constant communication with the War Office and the Home Secretary with regard to the street lighting, and he had received various instructions. At one time the lighting varied in different parts, but now it was uniform, this arrangement being adopted in January, 1917, after a conference at the War Office. It was then decided that certain lamps should remain out of lighting altogether. They were experimenting for a long time, and whenever the lights in Westminster had been varied this was carried out according to the instructions of the Government authorities. When they learnt that a lamp had gone out, the lighting company was notified, and they sent their men to put up a red storm lamp. There was a general arrangement between the Council and the company that the latter should do this. The usual procedure was that when a light went out the police called the attention of the company to it.

WILFRED B. THORPE, distributing engineer to the company, said in September, 1914, after consultation with the Home Office, the War Office and the Police, they had to vary the lighting, the instructions to his company coming direct from the Council. He had had complaints about these lamps in Cockspur Street that they were giving too much light, and they had to reduce it. They had to put metal shields on the lamps, besides painting them outside. The shields shut off the ventilation. In order to keep the lamps in order at night they were lighted between twelve and one o'clock in the daytime to see they were all right. They were again switched on at night, and an hour later the standard man passed up and down the streets on a bicycle to see if any light was out or burning badly. They kept a night staff to attend to any defect that might be reported, and men were sent out to attend to any lamp that had gone out. The first time he was told that this particular lamp in Cockspur Street had gone out was at 11.30 at night, when it was reported to them by the police. By an arrangement between the company and the Council carbons that wore away and had to be automatically renewed were attended to by the company. They had to keep the carbons at a "V"-shaped position, and in normal times the actual pressure kept them in place, but they had to reduce the pressure, and the results were very unsatisfactory. The lamps were never designed for the lower pressure. They could not expect the lamps to burn steadily. He could not explain why this lamp went out at the time of the first accident and was re-lit later, as was stated by the constable, but a lamp might go out through the reduced pressure and re-light later. They could not have avoided or foreseen this lamp going out.

Mr. BRANDON: Can you prevent the lights going out on low pressure?

WITNESS: I cannot prevent any lamp going out.

Mr. W. H. Kingston, your chief engineer, has written stating that if the current is reduced the burning of the lamp is erratic. Do you agree with that?—Yes, up to a certain point.

He added that he received a report at 11.30 that this lamp in Cockspur Street required attention and "danger," in consequence of which a red light was put up.

JUDGE HODGES, in his summing-up to the jury, said they should take into consideration the present condition of affairs, and that the country was at war. By consent the following questions were submitted to the jury, their replies being annexed:—

Q.: Was the accident due to an inevitable accident caused by the diminution of street lighting?—A.: Yes.

Q.: If it was not an inevitable accident, was it due to any negligent action on the part of the Council?—A.: Yes.

Q.: If so, what was the negligence of the defendants?—A.: Their omission to maintain a light on the refuge.

Q.: Was the accident contributed to by the plaintiff by his own negligence?—A.: No.

Q.: Was the lamp in question on the refuge alight at the time of the accident?—A.: No.

Q.: If not, what caused it to go out?—A.: In our opinion there is no conclusive evidence as to the cause.

His HONOUR reserved judgment until a point of law, which is to be raised by Mr. Lort Williams, on behalf of the Council, has been argued before him.

KENSINGTON & KNIGHTSBRIDGE ELECTRIC LIGHTING CO., LTD., *v.* NOTTING HILL ELECTRIC LIGHTING CO., LTD.—JUDGMENT.

IN the King's Bench Division on Friday last, January 18th, Mr. Justice McCardie gave a judgment of great interest bearing on the Electric Lighting Acts, 1882-1909, and the powers of authorities under Provisional Orders, in the case of the Kensington & Knightsbridge Electric Lighting Co. *v.* the Notting Hill Electric Lighting Co. This case, which came before the Court in the form of a special case, was argued before his Lordship recently, as already reported. The following is an abstract of Mr. Justice McCardie's judgment:—

The points at issue between these companies arise upon an award stated in the form of a special case by Mr. James Swinburne. In this judgment I shall refer to the Kensington Co. as the plaintiffs and to the Notting Hill Co. as the defendants. The primary question in the case is the construction of a short clause in a written agreement between the parties dated October 25th, 1900. That clause (so far as relevant) is as follows: "So long as any of the stock"—*i.e.*, certain debenture stock—"shall be outstanding, each of the two companies shall from time to time take from the joint station all such electrical energy as such company (having regard to its other sources of supply) may require for the purposes of its business in accordance with the provisions of the principal agreement."

Each of the two companies was duly registered under the Companies' Act in or about 1888. The memorandum of each

company gives broad and comprehensive trading powers. Each company became possessed of the usual statutory powers of supply. Time went on. It became apparent that, in order to meet the ever-increasing demand in both areas for electrical energy, it would be convenient to the companies if an additional source of supply could be provided. Accordingly, the plaintiffs and defendants entered into an agreement dated July 12th, 1899, called the principal agreement, that both companies should join in promoting a Bill in Parliament for enabling the two companies to establish a generating station outside the statutory area of supply of both companies.

On July 13th, 1899, an Act was passed in order to give effect to the contract. The recitals of the Act appear to contemplate that the supply from the joint station shall be given only to the respective statutory areas of supply of the two companies, and Section 5 of the Act provides (in essence) that the two companies "may respectively distribute the energy in such proportions and manner as the two companies may from time to time determine for the purpose of supply within their respective areas of supply, as for the time being authorised, or for giving effect to any agreement made under the provisions of this Act."

Shortly after the passing of the above Act the companies entered into a further agreement jointly with the trustees of certain debenture stock through the issue of which the new undertaking was to be financed. The agreement is dated October 25th, 1900. Clause 3 of such agreement has already been set out in this judgment. The joint station was duly erected at Wood Green.

By their Provisional Order of 1889, the defendants were expressly prohibited from supplying energy or laying down any electric lines or works beyond their area of supply otherwise than under the authority of Parliament, or under a licence granted by the Board of Trade. Adjacent to, but, in fact, outside, the area of supply of the Notting Hill Co. (the defendants) is a district called Kensal Town. To consumers within that district the defendants supplied energy in the year 1909. They *bona-fide*, but erroneously, believed that such consumers were actually within their statutory supply area. But they did not procure such energy either from the joint station or their own generating sources. They obtained it from a wholly separate source, and supplied it at a profit to the Kensal Town consumers. The plaintiffs contend that a breach of contract was thereby committed by the defendants. The arbitrator has held that the contention is well founded, and in respect of such breach he has awarded £189 damages.

The defendants, however, submit that their above-named acts do not constitute a breach of Clause 3 of the agreement of 1900.

Another and still more important point arises upon the special case. On November 25th, 1909, the Electric Lighting Act, 1909, was passed. By Section 6 of that Act the Board of Trade was empowered to grant licences whereby an undertaker could supply electricity to consumers outside his actual statutory area of supply. The licence may embody such powers and duties as are deemed appropriate by the Board of Trade. It is, I think, reasonably clear that the effect of a licence is not to extend an undertaker's statutory area of supply. It will operate only as a valid authority to supply electricity (in specially permitted cases) to consumers outside the statutory area. The actual statutory area with its special features of rights and duties remains untouched. Licences granted by the Board of Trade under Section 6 of the Electric Lighting Act of 1909 are commonly and conveniently known as "fringe orders."

In respect of the above-mentioned supply to Kensal Town consumers in 1909, no fringe order had been granted. The defendants, therefore, were acting *ultra vires* in giving the supply. But in the years subsequent to 1909 "fringe orders" were duly granted by the Board of Trade, whereby the defendants were authorised to supply electricity to various consumers in the Kensal Town district. Thereupon they supplied electric energy to such consumers. But they did not obtain it from the joint station, nor did they obtain it from their own generating sources. They procured it from a wholly separate source, and supplied it (at a profit) to such consumers. The plaintiffs contend that a further breach of contract was thereby committed by the defendants. The arbitrator has held that such contention is correct, and in respect of such breach he has awarded £1,661 as damages.

The defendants again submit that such last-named acts do not infringe Clause 3 of the agreement of 1900.

The determination of such matters primarily depends upon the true construction of Clause 3 of the agreement of 1900. The clause is difficult to construe. The word "require" is often of doubtful meaning. Its significance must depend on the context and on the special circumstances of the case.

In the light of the Act of 1899, which authorised the erection of the joint station, and of the general provisions of the principal agreement of July 12th, 1899, I think that the defendants in the present case were, *prima facie*, bound to take from the joint station all the electricity in fact needed for their business beyond the amount which they generated at their own sources of supply.

Mr. Tomlin contended that the word "business" meant (in the circumstances of the case) the supply of electricity to the defined statutory area of the defendants. Mr. Knox submitted that the word "business" was not so limited, but that the supply of energy under the above-mentioned "fringe orders," and also the supply (though *ultra vires*) by the defendants to Kensal Town in 1909 clearly constituted part of the business of the defendants.

In an ordinary case the phrase "Business of a company" would indicate the totality of the operations carried on by the company for the profits of its shareholders. But the word "undertaking" is more appropriate to the services rendered under statutory authority to a specified area in respect of gas, water, electricity, or the like. In the present case it is, I think, clear that the word "business" cannot bear the usual meaning indicated above. As already stated, the Notting Hill Co. possesses a Memorandum of Association with wide powers. The company may use electricity in any part of this country, or even outside the United Kingdom. It may trade freely in any place. It would also be within the powers of their memorandum for the defendants to secure a Provisional Order for the supply of electricity to York, or Exeter, or Chester. I deem it clear, therefore, that Clause 3 cannot mean that the defendants are bound to take from the joint station all the electricity needed for all the operations which may be lawfully undertaken by the defendant company as a trading corporation in any part of this country or abroad. It is therefore necessary to cut down the *prima facie* meaning of the word "business." What limit, then, is to be placed on the meaning of the word?

Mr. Knox submitted that the word "business" in Clause 3 should be taken as meaning the supply of electricity in their defined statutory area by the defendant company, plus the incidental supply by the defendants under fringe orders which might be granted from time to time by the Board of Trade in view of the convenient propinquity of fringe consumers to the area of supply, and plus also the supply to adjacent consumers, even though no fringe orders had been granted. But the defendants contend that such meaning cannot be yielded to such word in view of the relevant statutory provision in the earlier agreement and the circumstances of the case, and that I must, therefore, limit the meaning to the supply of electricity to the defendants' statutory area. Upon the whole, though with much doubt, and not without regret, I feel that I must accede to this contention of the defendants.

The agreement cannot be construed apart from the General Act of 1899, from which alone its efficacy is derived. Both the agreement of 1899 and that of 1900 depend for their juristic vitality upon the Statute. Nor can the agreement of 1900 be construed apart from the provisions of the earlier agreement of 1899. The two agreements are not ordinary commercial documents. They are special contracts made for a special purpose under the authority of a particular Act of Parliament. The apparent generality of words in such agreements must be limited by the circumstances of the case. The question of *ultra vires* arises in this case. It is a sound rule of law that a document should receive so far as possible such an interpretation as will confine the scope of the bargain to acts which may lawfully be done.

Stating his reasons for upholding the contention of the defendants as stated by Mr. Tomlin, his Lordship said: The agreements cannot go beyond that which is permitted by the enabling Statute. Now, if the Joint Act of 1899 be looked at it will be seen that the recitals deal in the clearest manner with the specific areas of the supply of the two companies, and with such areas only.

I am satisfied that Section 3 imposes a clear restriction "on the distribution of energy generated at the joint station." It cannot be distributed save within the respective statutory areas of supply. But the defendants' area of supply was precisely defined by their Provisional Order of 1899. I have already pointed out that a fringe order under Section 6 of the Electric Lighting Act, 1909, does not enlarge the statutory area of supply. It gives a particular and limited privilege in another area. It does no more. The actual wording of the fringe orders in this case supports the view I have just expressed. To my mind, they do not impliedly enlarge the area referred to in Section 5 of the Joint Act of 1899. I therefore think that the defendants were not entitled to employ any part of the joint station energy for the purpose of supplying those who were consumers under fringe orders. It follows that any agreements between parties that energy should be so employed would be contrary to the Joint Act of 1899, and therefore void. An agreement to do an *ultra vires* act is wholly unenforceable.

I hold that the true meaning of the word "business" is the supply of electricity within the statutory area. Even if the word "business" were to be taken as including a supply by the defendants to external consumers under the sanction of a fringe order, I should still feel disabled from awarding damages to the plaintiffs against the defendants for not taking the energy from the joint station. For they were not, in my view, entitled to take it, and I could not give damages for the non-performance of an act which was beyond the powers they possessed. It follows that the award is erroneous in respect to the item of £1,661.

As to Head (B), *i.e.*, the supply by the defendants to external consumers in Kensal Town in 1909, it results, in my opinion, that this part of the award, *i.e.*, for £189 damages, is also erroneous, subject to the subordinate point hereafter mentioned. Such supply was not a part of the business of the defendants within the meaning of Clause 3. Not only would a supply from the joint station for such consumers

have been beyond the powers and rights given by the Joint Act of 1899, but the supply was, in fact, in direct contravention of Clause 6 of the defendants' Provisional Order of 1889.

Two other points arise on the award. The first point arises as follows:—One of the consumers in Kensal Town was a Roman Catholic School. It was outside the defendants' statutory area of supply. But the school was adjacent to a church, and connected therewith. The church was within the defendants' area. The defendants conducted their supply to the school. They did not directly carry it themselves to the church. But the school had connected their fittings to the church, and thereby gave it a supply of electricity. Thus a building inside the defendants' area got a supply through a delivery of electricity by the defendants to a building outside the area. The energy supplied by the defendants to the school was not obtained by the defendants from the joint station, but from third persons. Such electricity could, and ought to, have been taken, I think, from the joint station. I see no reason for holding the defendants free from liability in respect of the electricity employed in the Roman Catholic Church. To so hold would offer the defendants a simple method of diminishing their obligation under the agreements of 1899 and 1900.

I cannot end this judgment without pointing out that the award now before me, which is stated in the form of a special case, does not contain any finding of fact save in one or two circumstances mentioned in paragraph 4 thereof. Mr. Swinburne is a most distinguished expert, and not a lawyer. But I feel that it is most desirable, and indeed essential, that every special case, whether stated by a lawyer or a layman, should contain a statement of every relevant fact as found by the arbitrator. In all future special cases I trust that the facts will be stated with clearness and fullness, and that the relevant documents will be specified in such case.

With regard to the costs of this special case, the defendants have succeeded to a large extent. But they have failed on some heads of the award, and several of their unsuccessful contentions occupied a substantial measure of time. Hence, I think that their costs should be taxed, and that they should receive two-thirds only of the total costs allowed.

With regard to the costs before the arbitrator, it suffices to say that he has dealt with them in the award with the exception of the small point arising (and already mentioned in this judgment), as to the supply to the church.

CLONES ELECTRIC LIGHT & POWER CO. *v.* COMMISSIONERS OF VALUATION.

IN the Court of Appeal, Dublin, on 17th inst., before Lord Justice Ronan and Lord Justice Molony, an appeal was heard in which the Commissioners of Valuation appealed from a decision of King's Bench Division on a case stated by County Court Judge Johnston. The Clones Co. had appealed against an assessment of £100 upon the company's lighting and power equipment as being excessive, and the judge had reduced it to £75, apportioning £25 to the buildings, &c., and £50 to the mains, poles, and easements. In the King's Bench the parties agreed to the value being ascertained by reference to profits. The Court, without expressing any opinion as to the propriety or applicability of such principle, affirmed the judgment of the County Court Judge, with costs against the Commissioners. In his judgment Mr. Justice Gibson had expressed disapproval of the valuation adopted by the parties, on which the County Court Judge had been asked to decide. The Court affirmed the decision of the King's Bench Division, and dismissed the appeal with costs. They stated, however, that they were not to be taken as expressing any opinion on the question in Mr. Justice Gibson's judgment as to whether the method of valuation adopted was a correct method or not.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Wages in Central-Station Service.

When I came to "Situations Vacant" in this week's REVIEW, I had to look twice at the date to make sure it was January 18th, 1918, and not January 18th, 1913, printed at the top of the page.

We have thus:—

WALTHAMSTOW.—Switchboard Attendant wanted; wages 56s. 3d. for 56-hour week, rising to 62s., *including* war bonus.

Assuming bonus to be the 20s. + 12½ per cent., this is equivalent to a pre-October, 1917, rate of 30s. per week.

ROCHDALE.—Meter Tester; commencing *salary* £2 5s. per week, *including* bonus.

Assuming as above, this equals a pre-October rate of £1 per week.

WARRINGTON.—Junior Shift Engineer; *salary* £2 15s. per week (including war bonus of 10s. per week).

ERITH.—Shift Engineer; *salary* £130 + 15 per cent. bonus—*i.e.*, 7s. 6d. per week.

TUNBRIDGE WELLS.—Shift Engineer; *wages* 35s. per week + 5s. per week bonus.

With regard to the last three instances, the Askwith award is not being complied with. Why?

With particular regard to the last example, further on we see—

TUNBRIDGE WELLS.—Wanted, Engine Driver; wages 35s. per week + bonus (amount not mentioned).

Will it be more than 5s.?

Compare with wages for shift engineer at the same station!

There are others!

In conclusion, a labourer at 7½d. per hour, working 54 hours per week and receiving 20s. bonus + 12½ per cent., earns £157 4s. 3d per annum—a little over £3 per week!

En Avant.

The 12½ per Cent. Bonus.

A state of doubt seems to prevail in regard to the application of Sir G. Askwith's decision.

A consideration of its origin, however, lends a principle of guidance. The decision was given primarily under the Munitions of War Act, 1916, this Act covering all electric supply undertakings which are certified by the M. of M.

The award specifies no restrictions *quâ* locality, so is to be construed as universal throughout the country, in so far as the above undertakings are concerned.

This consideration of the case, of course, excludes undertakings not certified by the M. of M., and not parties to any agreement.

T. W. Cole,

Secretary, Provincial Electric Supply Committee of the United Kingdom.

Moorgate Court, E.C., *January 22nd*, 1918.

[A circular communication to the members of the I.M.E.A. on this subject is reported elsewhere in this issue. Other letters, received too late for inclusion, have been held over.—EDS. ELEC. REV.]

Prof. Walker's Battery Rule.

Having heard that the rest of us will think to-morrow what Manchester thinks to-day, your readers may be interested in the new battery rule by Prof. Miles Walker, of the Manchester School of Technology. Some of them, indeed, may find the matter a very important one; for this rule is founded on a misunderstanding, and Manchester students will certainly lose marks if they use it at examinations outside their own school.

I wrote to the school in October last, pointing out that they were wrong in thinking the old rule could be otherwise stated in this way: "Make $p\,q$ as nearly as possible equal to $r\,s$"; where p is the number of rows in parallel, s the number of cells in series in each row, r the resistance of each cell, and q the external resistance. They had argued that this "is, of course, equivalent to the rule—Make q as nearly as possible equal to $r\,s/p$"; and they quite rightly remarked that this latter is identical with Prof. Perry's rule—"Arrange the battery so that its internal resistance shall be as nearly as possible equal to the external resistance" ("Calculus for Engineers," page 52). But I drew attention to the fallacy in the first part of this argument, and clinched the matter by taking the simple example of 26 1-ohm cells and an external resistance of 3 ohms; here the first rule tells us to make $s = 2$, while the second tells us to make $s = 13$, which more than doubles the current.

It was then suggested that I had overlooked the possibility of arranging six of the cells in this way $\begin{matrix}0\ 0\ 0\ 0\ 0\\ 0\end{matrix}$ to suit an external resistance of 4½ ohms, and so on in other cases. But I pointed out that these irregular and inconvenient groups are clearly excluded by Prof. Perry's assumption that the battery resistance is $r\,s/p$; for this expression does not represent the battery resistance unless p is an integer; and it will be seen that the same assumption is actually made in the above-quoted argument that I had received from Manchester.

I also showed that the proposed modification of the usual rule will sometimes *prevent* the student from getting the greatest current. Taking, for example, the above case in which the internal and external resistances are each equal to 4½ ohms, we find that the current is $5\,e/9 = 0{\cdot}555\,e$ (where e is the electromotive force of each cell); but the old rule tells us to put the cells all in series, which gives us the greater current of $6\,e/10\frac{1}{2} = 0{\cdot}571\,e$. However, as I have elsewhere demonstrated (*Mechanical World*, dated April 20th, 1917), Prof. Perry ought to have said, "Make $p\,q$ as near as possible to $r\,s$"; this very short and convenient rule will infallibly indicate the battery (of the usual regular form) that gives the greatest current; but we sometimes get only a small fraction of this current if we use Prof. Perry's rule.

Instead of getting a frank admission that the Manchester teaching has been wrong, I am told that "this discussion must now close until after the conclusion of the war." But the war may last a long time yet, largely because our professors have been so far behind those of Germany; and I therefore hope you will now find space for this letter.

W. F. Dunton.

Newcastle-on-Tyne, *January 21st*, 1918.

Illuminating Engineering.

My previous letter scarcely conveyed, I am afraid, the true cause for my criticism on Mr. Trotter's exceedingly interesting address to the Illuminating Engineering Society.

It related only to his expression, "The eye only is the judge,"

which to my mind is an unfortunate phrase, although a popularly accepted one in relation to illumination results. It requires, however, for the majority of the public an analysis or extension of thought which is seldom attached to it, and, therefore, misleads them into forgetfulness of the fact that in reality the mind, and not the eye, passes judgment, for the latter is merely a "servant" to carry impressions to the brain, the quality or refinement of which and their consequent approval by the mind is determined solely by the degree to which it (the mind) has been trained on the subject.

A high standard of illumination is assuredly not readily appreciated by the mind at the present day, and speaking as a commercial man who has devoted much enthusiasm to the subject, it is scarcely an exaggeration to affirm that the average man's appreciation at first sight is almost in inverse ratio to the standard of excellence supplied, because the eye or mind can but give verdicts in proportion to the consciousness of its requirements.

For this reason did I regret such an expression coming from Mr. Trotter, more so from him than from a less eminent authority, because it tends to confirm the popular error that the mind can capably express judgment without adequate tuition, and accordingly, to the despair of commercial men, no demand for a higher standard of illumination would be created by the public than has satisfied them for ages past.

We know, for instance, that an installation with a given foot-candle intensity and low diversity factor makes a higher standard for maintaining visual efficiency, than one with a higher average foot-candle intensity and bad diversity factor.

I would ask, however, in how many cases would the former standard be selected by the public when appeal to the eye were made?

In fact, not even a mind educated on the subject could rely upon sense of sight in order to rate the value of a diversity factor, which is, perhaps, of primary importance in at least industrial installations.

I further suggest, from practical experience, that it is an error to suppose that the workman at a machine is so satisfactorily served by a high intensity of illumination immediately at the position of work, as by a lower intensity equally spread over the whole area upon which the eye roams. But the sense of sight would convey to most minds a preference for the former.

Upon such elementary facts Mr. Trotter will doubtless be in agreement with me; but I believe that if, instead of apathetically accepting judgment from the eye by the public, more cause for effect were preached in simple language, commercial men would readily appreciate and quickly demand diffusion and diversity factor owing to their important relation to output, &c., and thereby the chief obstacles to the progress of the illuminating engineering movement would be removed.

Sydney O. Cook.

Glasgow, *January 21st*, 1918.

The Production of Ductile Tungsten.

I trust you will forgive me for trespassing on your space again on the above subject, but it seems to me that the letter in your issue of January 11th, signed by Messrs. Speechly, Mumford, and Craig, calls for a reply. Notwithstanding the remarks of that firm of solicitors, I think my original statement was substantially correct, and that it is proven by the following statement to the effect that "the total production of tungsten wire drawn at Rugby, as evidenced by the production sheets, was 5,835,686 ft." This amount, adopting the calculation of Speechly, Mumford & Craig, was ample for all the lamps made and sold by the B.T.H. Co. The lamps imported from America were small in number (less than 1 per cent. of the B.T.H. Co.'s total sales), and they were entirely special.

However, if it will satisfy Speechly, Mumford & Craig and the amused lamp manufacturers, I will correct my original statement, so as to make it read as follows:—"The British Thomson-Houston Co. were supplying their whole requirements of ductile tungsten for lamp filaments in 1912 by manufacture at their Rugby works from material some of which had been partly treated in America."

After all, it is quite unimportant as to whether the whole requirements of the B.T.H. Co. were made at Rugby in 1912, 1913, or early in 1914, so far as my original letter on the *Daily Telegraph* report of Mr. Johnstone's lecture was concerned. What was material was that the B.T.H. Co. were manufacturing ductile tungsten before the outbreak of war. They had been manufacturing it from tungsten oxide for a long time prior to August 2nd, 1914, and, by the way, they started manufacture from tungsten ore mined within the British Empire, in the beginning of December, 1914.

Before closing this letter and the correspondence, so far as I am concerned, I would like to express my surprise that Speechly, Mumford & Craig should now use in this way information acquired from confidential works records, copies of which they obtained by process of law from the B.T.H. Co. in the case which they mention. These records were secured in an attempt by the defendants to bolster up a plea, which from their own knowledge they were unable to prove, that the B.T.H. Co. had not been working Patent No. 21,513* of 1906, to an adequate extent in this country. Evidently they could not support the plea, for the issue was never tried, and although Mr. Fraser's affidavit may be a public document, the production sheets never became such. It may be of interest to state that the defendants were directed to pay the costs of the B.T.H. Co. on the issue.

The case is still *sub judice*, and the remaining issues decided upon by Mr. Justice Astbury and the Court of Appeal will be reviewed by the House of Lords at an early date.

I need hardly comment on the boastful paragraph at the end of Messrs. Speechly, Mumford & Craig's letter, beyond saying that the British public may take comfort from the fact that at least two concerns in this country are each able to supply the whole of the demand for drawn tungsten filaments.

John Gray.

London, E.C., *January 22nd*, 1918.

Meters on a Changed Frequency.

Many thanks to Mr. T. Urmston for his answer on above. The type of meters now in use are induction meters of the following makes:—Westinghouse, Aron, Siemens, A.E.G., B.T.H. There are about 800 in circuit, the bulk of which are 3-ampere, installed in colliers' houses. There are no power circuits connected. Are the figures given by Mr. Urmston actual tests taken with the 50-period meter on the 40-period circuit?

Query.

Cable Breakdowns.

The REVIEW of September 7th, 1917, contained an article similarly entitled to mine of August 24th—namely, "V.B. Cable Breakdowns in the Tropics."

Mr. Beaver therein, after describing his investigations, of which I was not ignorant by the way, goes on to state that the incorporation of a small proportion of high-grade vulcanised rubber with the bitumen affords "a surprising degree of protection" against the softening process.

Will Mr. Beaver state if cables made in this way have been tried under actual working conditions for any length of time, and, if so, with what results?

I regret that such a long time must elapse between Mr. Beaver's article and my letter, but my address will furnish the reason.

D. M. W. Hutchison.

Kuala Lumpur, F.M.S.,
November 29th, 1917.

BUSINESS NOTES.

"Ceag" Shares for Sale.—The Public Trustee is offering for sale 2,500 preference shares of £1 each, and 22,300 ordinary shares of £1 each, all fully paid, in the "Ceag" Electric Safety Lamp Co., Ltd. Tenders have to be delivered by February 8th.

Electrical Manufacturing in Australia.—The *Board of Trade Journal* states that a firm of engineers at Victoria, which has for some years specialised in the manufacture of pumping plants, has completed arrangements to manufacture electric motors up to 50 H.P., on the A.E.G. models.

The Greaves-Etchells Furnace.—Although this furnace was not introduced until 1916, says the *Sheffield Daily Telegraph*, the number of orders it has secured in Great Britain stands second only in the list of makers. The numerous plants installed in Sheffield and various parts of the country are employed on alloy steels, high-speed steels, carbon steels, and steel castings. The Government of the United States have ordered five of them, of large capacity, for their arsenals and dockyards, whilst other orders have been received from such world-famed concerns as the Halcomb Steel Co., the National Radiator Co., the Singer Manufacturing Co., Ford Motor Co., the Stoddart Union Steel Co., the Primos Chemical Co., and others. That the furnace has a great future in America is now assured. Three of the same type are now on order for armament works in Spain, and one is being supplied to New Zealand, to be employed in producing steel castings from scrap. The furnaces in Sheffield have turned out a considerable tonnage of high-speed steel of satisfactory quality.

Book Notices.—"*Journal* of the Institution of Electrical Engineers." Vol. LVI. No. 270. January, 1918. This issue contains the following papers:—"Gas-Firing Boilers," by Mr. T. M. Hunter; "Electrical Cooking as Applied to Large Kitchens," by Mr. W. A. Gillott; "Electricity Supply in Dublin and the Surrounding Districts," by Mr. W. Tatlow.

"The British Engineering Index and Buyers' Manual for 1918." Compiled by F. J. Turquand. London: E. T. Heron & Co. Price 10s. 6d. net.

"Scientific Papers of the Bureau of Standards." No. 309. A Method for Testing Current Transformers. Washington: Government Printing Office. Price 5 cents.

Charge of Stealing.—Two men, who pleaded guilty to a charge of having stolen from the Clyde Valley Electric Power station at Cambuslang brass fittings to the value of £100, were sent to prison by Sheriff Shennan, Hamilton, for 21 days.

France.—A new company has lately been formed in Paris, with a capital of £80,000 and the title La Société de Forces Motrices de la Garonne, to acquire and extend the carbide manufacturing business of Messrs. J. Cartier & Co. and to establish plant to utilise water power in the generation of electrical energy.

Catalogues and Lists.—ENGINEERING AND ARC LAMPS, LTD., Sphere Works, St. Albans.—New six-page illustrated list of a number of specially-designed fittings suitable for use with half-watt lamps. The patterns shown are for works and industrial lighting—interior and exterior. Prices, dimensions, code-words, and other details are tabulated.

LEY'S MALLEABLE CASTINGS CO., LTD., Derby.—Twelve-page booklet entitled "Does Time mean Money to You?" and containing a reprint from the ELECTRICAL REVIEW, of September 7th, 1917, of the illustrated description of an "Improved Method of Time Checking" (The Ley-Allin System).

"Z" ELECTRIC LAMP MANUFACTURING CO., LTD., Southfields, London, S.W. 18.—Illustrated and priced leaflet of various types of electric flash lamps; also small postal enclosures relating to various accessories.

Liquidations.—MCPHAIL & SIMPSON, LTD.—Through the expiry of the lease of the works at Wakefield and the consequent disposal of the business and most of the plant, this company is winding up voluntarily, with Mr. G. E. Levie as liquidator. Meeting of creditors, January 30th, at Finsbury Pavement House, E.C.

Trade Announcement.—The address of the Sheffield branch of the INDIA-RUBBER, GUTTER-PERCHA AND TELEGRAPH WORKS CO., LTD., is now 88-90, Queen Street, Sheffield, instead of 28, Angel Street.

LIGHTING AND POWER NOTES.

Birmingham.—NATIONAL ELECTRIC SUPPLY.—In a recent interview on the proposals of the Coal Conservation Sub-Committee, Mr. R. A. Chattock, the City Electrical Engineer, expressed thorough agreement with the necessity of securing more efficient production of electrical energy, though differences of opinion would arise as to the methods to be employed. The division of the country into 16 areas was open to revision; in the Midland area, embracing Birmingham and the Black Country, it was not easy to obtain suitable facilities in any one place for the large power station required. It might be as economical under some conditions to put up several power stations in a district rather than to have one only; it depended largely on water facilities.

The effect on the charges to consumers of the cost of transmission from large stations into the areas of supply had to be borne in mind, as the saving in economical generation may be lost in transmission over a distance. So far as the Birmingham area was concerned, he did not think it would be possible, owing to lack of natural facilities, to generate at one point, though it could be done at several points. The preliminary investigation of the development possibilities of an area, and the methods to be employed, would involve an enormous amount of work. With only an interim report to go upon, it was impossible to go into details of control and administration; there was no doubt, however, that given compensation for any interference with existing rights, centralisation leading to economical production was to be commended.

Mr. Chattock expressed pleasure that the suggestion to gasify fuel, &c., is made contingent upon the methods adopted being perfected. At the present time great expenditure in this direction would not be justified; and it must not be forgotten that what might be best from a national point of view, might not be to the advantage of the supply industry. In view of the enormous business organisation to handle, perhaps, eight times the coal now required to generate a given quantity of electricity, and to handle by-products, the present business of electric supply might become almost an off-shoot of the larger organisations, with the possible danger that the interests of the supply consumers may be jeopardised by the possible failure of one or more of the other branches.

Blackpool.—In connection with the taking over of the urban district of Bispham, the Parliamentary Committee has instructed the electrical engineer to report on the utilisation of the existing electricity works.

Burnham (Somerset).—PRICE INCREASE.—The Electric Supply Co. has informed the U.D.C. that the price of electricity has been increased from 6d. to 7d. per unit.

Callan (Co. Kilkenny).—FIRE.—Damage estimated at £3,000 resulted from an outbreak of fire at the electric lighting station, almost the entire building and plant being destroyed.

Continental.—TURKEY.—According to a report from Constantinople, great attention is at present being paid to the question of developing and utilising the water-power resources of the country. It is consequently expected that there will be an important demand in the country for turbines and allied plant after the war.

Dublin.—The Port and Dock Board has considered a report from its electrical engineer on the question of the supply of electricity for the use of the Board's appliances. The cost of running the power station was estimated in 1904 at £2,000 per annum; this had now increased to £5,000 per annum, or approximately 2¼d. per unit delivered. The question of thoroughly overhauling the existing plant or installing new, raised the question as to whether the Board should continue to generate its own energy or purchase in bulk. The former would entail a capital expenditure of at least £6,000 within three years, the installation of new plant would cost £14,000 to £16,000, of which about one-half would be for reserve plant. In the event of purchasing energy in bulk from the city supply, the necessary converting plant would cost about £5,000, and the City Corporation should be in a position to give a bulk supply at under 1d. per unit; by adopting this suggestion it would be possible to make a saving of £2,000 a year in running costs and £10,000 in capital expenditure.

If the Board decided to take over the provision of electric power in the reclaimed district, it would be possible to arrange a self-contained system capable of expansion when needed, suitable for the requirements of a commercial district, the energy being purchased in bulk on the cheapest and most advantageous terms.

It was, however, necessary to secure a temporary supply for the tenants of the Board; such supply should be capable of expansion into a permanent one to that district, and be able to deliver energy at a price which would enable the new industries arising to have a fair chance of success, and this he considered could only be reached if the supply could be given for less than 1d. per unit. The general proposition of the supply was, however, narrowed down to the question of crossing the Liffey; this could be done by submarine cables, aerial cables, or by tunnel, alternative methods placed in the order of cost; the first was unreliable for high voltage, while the towers to support the cables would cost approximately £8,000, and a 6½-ft. tunnel about £22,000. Whichever method of crossing the Liffey the Corporation should ultimately adopt, provision should be made for carrying the Board's cables, in addition to those of the Corporation. The matter is to be considered at a special meeting.

The Lord Mayor (Councillor L. O'Neill) held an inquiry into statements made at a recent meeting of the Corporation regarding the collection of electricity accounts, and also investigated the allegation that an official of the Council owed an account of ten years' standing. The books were placed at his Lordship's disposal, and several witnesses were examined, and at the close it was intimated that a report would be made to the Council.

London.—ST. PANCRAS.—Mr. Baynes, the chief electrical engineer, has reported to the Electricity Committee that, having regard to the increasing power load, it is desirable to obtain two Ljungstrom turbines, at a cost of £35,000; it is also necessary to spend the following amounts:—Foundations, £900; switchgear and connections, £1,000; pump house and circulating pipes, also all other pipe work, £5,000. If the foregoing were carried out, the two Browett-Lindley engines could be done away with, and with the present shortage of machinery on the market, probably a fair sum could be got for them. With facilities, the makers could deliver the two proposed new sets in seven or eight months. The present load is over 6,000 KW., but, owing to shortage, they were unable to keep up the full pressure on the mains at maximum load times, otherwise this figure would reach some 6,500 KW., and he anticipated a considerable further increase on this figure. During the 12 months to date, they had generated over 17½ million units, and consumed 37,000 tons of coal. By running the two 3,000-KW. turbines, with the new boilers helping, they could handle all the present load with modern plant, and effect an economy in coal of about 14,000 tons per annum, which would secure a saving of nearly £22,000. He submitted that the installation of this new machinery would be a good commercial proposition, while the reduced coal traffic would be of benefit to the railways. In recommending the installation of the Ljungstrom sets, he found that this type was more economical for their purpose; further, any attempts to put in a 5,000-KW. set would involve considerable expenditure in alterations to buildings, and the provision of a new travelling crane. The Committee is in agreement with the engineer's recommendation, and a deputation is to interview the Ministry of Munitions regarding the completion of the coal-handling plant at King's Road Station.

L.C.C.—The Finance Committee recommends the sanction of the Council to the borrowing of £3,000 by the Bermondsey B.C. for a rotary converter for the electricity department, and £53,000 by the Islington B.C., made up as follows:—5,000-KW. alternator, condenser, and switchgear, £28,000; two water-tube boilers, &c., £14,000; coal-bunkers and conveying plant, £11,000.

A conference of representatives of municipal electricity undertakings was held at Caxton Hall on January 16th, to consider the question of bulk supply in the London area; a further meeting is to be held.

FULHAM.—The Electricity Committee reports that the power station load during the week preceding Christmas reached 4,300 KW. as against 3,000 KW. in pre-war days.

For the purpose of dealing automatically with the ash from the boilers at the electricity works, and for conveying coal to the new boiler furnaces, the Committee recommends that a suitable clinker-handling plant and coal conveyor be obtained, also an efficient coal weighing apparatus, at a cost of £1,900.

Monasterevan (Co. Kildare).—Electric lighting has been installed at a cost of £3,000.

Mytholmroyd.—PROV. ORDER.—The U.D.C. has passed a resolution agreeing that the Halifax Corporation should make application for a provisional order under the Electric Lighting Acts, 1882 and 1909, authorising the Corporation to supply electricity within the whole of the urban district, and consenting to the granting of such order by the B. of T.

Rawtenstall.—PROPOSED LOAN.—The T.C. has decided to apply to the L.G.B. for sanction to borrow £5,500 for new plant at the electricity works.

Rotherham.—A town's meeting has approved of the proposed promotion of a Parliamentary Bill in the next session of Parliament, which, among other things, provides for the purchase of the electricity undertaking of the Mexbro' and Swinton Tramways Co. and the extension of the Corporation generating station in Rawmarsh Road.

Stroud.—E.L. POWERS.—The R.D.C. has decided to oppose an application by Messrs. Edwards & Armstrong to take over the powers of the Gloucestershire Electrical Power Co., formed in 1902, and which never carried out the provisions of its Bill in the Stroud rural area.

Wigan.—HOSPITAL LIGHTING.—The Sub-Committee of the Board of Guardians appointed to consider the lighting arrangements of the hospital at Billinge, has received a report from Mr. G. S. Corlett, who is of opinion that the only satisfactory method of lighting the hospital by electric light is from a generating plant on the premises. The capital expenditure for the provision of 334 lights would be £1,800, and the working expenses were estimated at £212 10s. per year. It was further estimated that electricity would show a saving of over £500 yearly. The Sub-Committee recommended that application be made to the military authorities for approval of the scheme, and that they be asked to bear one-half of the capital expenditure.

Willesden.—Negotiations are proceeding between the U.D.C. and the North Metropolitan Electric Power Supply Co. for the continuation of bulk supply to the Council after March 31st, 1918. Application is to be renewed to the L.G.B. for permission for the Council to install two new 500-KW. rotary converters, at a cost of £5,400.

Worcester.—At a meeting of the Chamber of Commerce reference was made by Mr. Fairbarn to the proposals of the Coal Conservation Sub-Committee. He was given to understand, he said, that the Stourport proposal for the erection of a power station was rather in anticipation of the scheme which would be considered by Parliament. If the Chamber expressed any opinion he thought they should take the view that these gigantic stations should be owned nationally and not by private undertakings.

Yorkshire Electric Power Co.'s Bill.—A special meeting of the Slaithwaite, Golcar, and Linthwaite Councils has decided to oppose the above Bill. The Barnsley T.C. is recommended to join neighbouring County Boroughs in opposing it. The Clayton U.D.C. has also decided to oppose it, and the Greasborough U.D.C., in view of its pending application for a provisional order for electric lighting, has decided to oppose both the company's Bill and that of the Rotherham Corporation.

The Earby U.D.C. is joining a conference of the urban authorities of Keighley, Skipton and Barnoldswick, with a view to joint opposition to the Yorkshire Bill.

TRAMWAY AND RAILWAY NOTES.

Blackburn.—The Corporation tramway receipts for the nine months of the current tramway year are about £10,000 above the corresponding period of 1916-17.

The members of the local branch of the Amalgamated Association of Tramway and Vehicle Workers have tendered notices to cease work on February 1st, unless their claims are settled. They ask for the payment of a war bonus, in full, as granted by the Committee on Production; the total abolition of fines; the employment of discharged sailors and soldiers in preference to others; the abolition of "the present competitive current bonus system"; recognition of the Society and its officials, and the imposing of a condition that all employés in the department, other than skilled craftsmen, shall be members of the Association. Mr. J. H. Cowell, general manager of the tramways, stated that the full war bonus is already being paid. The "fines" referred to are deductions made when, say, employés are late for duty, causing others to have to do the work; the current bonus is an award for carefulness, and not a competition, and work will be found for any discharged sailors and soldiers who are fit. All Unions are recognised equally, and the demand that all shall be members of the one Association is a matter for the men, and not the management. There are 300 employés in the department, but it is not known how many belong to the Association.

Halifax.—Proposed reductions of the tramway service, including advanced fares and the discontinuance of the Warley Road route, have raised many protests from citizens and organised traders. The Chamber of Trade asked that the fares should not be increased until Bradford and Huddersfield take similar action. Transfer tickets were abolished as from January 12th, but the other changes were postponed until the Tramways Committee has come to a final decision.

Keighley.—WAGES.—The award of the Committee on Production in connection with the recent wages dispute on the tramways, grants to youths under 21 an advance of 7s. 6d. per week above pre-war rates, beginning on the first pay day in January, payable at the rate of 1s. 3d. per day or per shift worked. Having regard to the statutory rules and orders made by the Minister of Munitions in accordance with the Munitions of War (Amendment) Act, 1916, no order is made as to the women's rates. The employés' demand was for the youths and also women to have the same advance on pre-war rates (15s.) as was granted the men in November, and that Sunday labour be paid at the rate of time and a half and all ordinary overtime at the rate of time and a quarter. The Committee on Production has ruled that the claim for Sunday and overtime pay has not been established.

Leeds.—PARCELS SERVICE.—The tradesmen in the city have agreed to utilise to the fullest possible extent the new tramway parcels carrying facilities which are to be established. Further steps in the matter were taken by the Tramways Committee last week, and arrangements are being made for receiving stations in the outskirts of the city. The scheme will be in operation in about a month.

The Tramways Committee proposes to abolish some of the stopping places in Boar Lane and Briggate, and to adopt a new queue system.

The Committee has decided to recommend the suspension of the most distant suburban tramway services to Street Lane and Lawnswood. The two districts can be served by way of Moortown or Canal Gardens and West Park respectively, and the idea is to concentrate more cars on busier lines, and also to pull up some rails for use in urgently-needed repairs.

The War Pensions Committee, last week, decided to approach the Tramways Committee in regard to the case of a discharged soldier suffering from sciatica, who had been employed for 13 years in the tramways department, and was promised that his place would be kept open, but who, on return, was told there were no vacancies. The general opinion of the Pensions Committee was that this was a bad example on the part of a Corporation department. The secretary was instructed to prepare a return of ex-Corporation workmen who had been unable to get work on return from the Army.

Liverpool.—WAGES.—The Tramways and Electricity Committee has recommended to a Special War Bonus Committee that tramway employés should receive an additional war bonus of 5s. per week for men, and 3s. for women, thus bringing them to an amount equivalent to that of employés of other tramway undertakings in the district. An application from employés in the electric supply department for munitions time-workers' bonus, recently extended to electrical workers by the Committee on Production, has been granted.

London.—L.C.C.—The Highways Committee has submitted to the Council a report dealing with the congestion of tramway traffic at Victoria. It is stated that during the busiest hours of the day the number of cars departing from the Victoria terminus, which is a "dead end," averages about 80 an hour, and the number of passengers boarding and leaving the cars is greater than at any other terminus in London. The Highways Committee proposed, as the best solution of the difficulties, the construction of a loop line *viâ* Gillingham Street and Wilton Road, but neither the Commissioner of Police nor the Westminster City Council will give consent. To partly meet the difficulties in dealing with the traffic, an additional cross-over is to be installed, which will increase the number of cars loading simultaneously from 4 to 6.

The cost of applying the bonus of 12½ per cent. to persons employed on hourly or weekly wages in the electrical branch of the tramway department is estimated at £4,025 in the current financial year and £9,125 in 1918-19.

Southport.—TRAMWAY PURCHASE.—As the result of negotiations that have been in progress for the past year, the General Purposes Committee of the T.C. has decided to purchase the undertaking of the Southport and Birkdale Tramways Co. for the sum of £35,000, as and from January 1st, 1918, the company making a payment of £1,200 to the Corporation on revenue account, in addition to rent outstanding at the end of 1917. The company agrees that the payment of the purchase money may be deferred at the option of the Corporation until July, 1922, subject to payment of interest at 5 per cent. The company's lease of its lines in Southport would expire in 1922, and those in Birkdale in 1937. The arrangement for deferring the payment of the purchase money is made to avoid the difficulty of raising a loan during the war. The necessary steps are to be taken at once for the transfer of the undertaking.

TELEGRAPH AND TELEPHONE NOTES.

Long-Range Wireless.—In connection with Commander Cresswell's statement regarding the reception at various Australian wireless stations of messages sent out by Nauen and other places in Germany, the *Auckland Weekly News* states that similar messages are received nightly at several of the New Zealand radio stations, especially Awanui, which is probably the best equipped in the Dominion. The distance from Nauen to Awanui is about 12,000 miles. The secret of these remarkable results, which in less troublous times would excite world-wide interest, is said to lie in the De Forest ultra-audion receiver.

United States.—The U.S. Navy high-power wireless station at Pearl Harbour, Hawaiian Islands, was opened recently, and messages were exchanged with Washington, a distance of about 5,000 miles.—*T. and T. Age.*

Wireless Operators' Demand.—It is understood that the Association of Wireless Telegraphists, which has a membership of over 2,000, has presented a demand to the Ministry of Shipping for an immediate increase of 100 per cent. on pre-war rates of wages. The demand has been submitted by the Ministry to the Deck Officers' Panel of the Conciliation Board, but the Association's executive complain that, although their organisation is representative of all the highly skilled wireless operators in the service, no representative of the Association has been invited to take part in the proceedings. The Marconi Wireless Co. have intimated that if a majority of the members express a desire, "recognition" will be extended to the Association.—*Daily Telegraph.*

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—MELBOURNE.—April 5th. Department of the Navy. Motor-driven hydraulic pump. Director of Navy Contracts, Melbourne.

February 2nd. Waterworks department. Electrically-driven radial arm crane. See "Official Notices" January 4th.

ADELAIDE.—February 27th. P.M.G.'s Department. Telephone material. Schedules 479 and 483. See "Official Notices" January 18th.

Glasgow.—The electrical engineer is to obtain offers for two further sets of generating plant for Dalmarnock Works.

Manchester.—January 29th. For supply, &c., at the Stuart Street generating station, of three-phase motors for cooling tower fans for the Electricity Committee. Specifications, &c., from F. E. Hughes, Secretary, Electricity Department.

Warrington.—January 29th. Turbo-alternator foundations for Electricity and Tramways Committee. Borough Electrical Engineer.

CLOSED.

Australia.—The Melbourne Tramways Board has accepted the tender of the Australian General Electric Co., Ltd., at £39,720, for the supply of electric lighting plant and apparatus in the whole of the cars employed on the service.—*Tenders.*

Eastbourne.—The T.C. has accepted the tender of Maden and McKee, Ltd., of Liverpool, for the purchase of 150 KW. of plant at the electricity works, at £160.

R.D.C. Electric cable: G. H. Watkins, £72.

Glasgow.—The City electrical engineer has reported upon his negotiations with the British Westinghouse Co., for the purchase of a second set of turbo-alternators, to the same specification as the set at present being manufactured by them for this department. The Committee has agreed to purchase from the company a second 15,000-KW. set for Dalmarnock, at £110,000.

The Tramways Committee has accepted the following tenders:—

Trolley wire.—Fred. Smith & Co., Ltd.
Armature coils.—P. R. Jackson & Co., Ltd.

Government Contracts.—List of new contracts placed December, 1917:—

WAR OFFICE.

Chatterton's compound.—General Electric Co., Ltd.
Generating sets.—Coventry Simplex Engines, Ltd.; W. H. Dorman & Co., Ltd.; R. A. Lister & Co., Ltd.

H.M. OFFICE OF WORKS.

Engineering works, Bramley O.W. Stores; extension of generating plant: engine, generators and switchboard, R. Hornsby & Sons, Ltd.; British Thomson-Houston Co., Ltd.; suction plants, H. Simon, Ltd.
New Science Museum, Food Controller: Lift, Waygood-Otis, Ltd.; St. James' Park Ministry of Shipping, electric wiring: Duncan, Watson and Co.

POST OFFICE.

Protective apparatus.—Siemens Bros. & Co., Ltd.
Telephone apparatus.—British L. M. Ericsson Manufacturing Co., Ltd.; Walter's Electrical Manufacturing Co., Ltd.; Western Electric Co., Ltd.
Buzzer indicators.—Creed & Co., Ltd.
Submarine cable.—Telegraph Construction and Maintenance Co., Ltd.
Telegraph cable.—W. T. Henley's Telegraph Works Co., Ltd.; Johnson and Phillips, Ltd.; Siemens Bros. & Co., Ltd.; Telegraph Construction and Maintenance Co., Ltd.
Telephone cords.—London Electric Wire Co. and Smith's, Ltd.; Peel-Conner Telephone Works, Ltd.
Stoneware ducts.—Doulton & Co., Ltd.
Insulators.—J. Macintyre & Co.
Telephone mouthpieces.—Crystalate Manufacturing Co., Ltd.
Cable distribution plugs.—British Insulated and Helsby Cables, Ltd.
Saddles for poles.—A. Kenrick & Sons, Ltd.
Pole steps.—Guest, Keen & Nettlefolds, Ltd.
Paraffin wax.—Young's Paraffin Light and Mineral Oil Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.
Flame-proof wire.—C. Macintosh & Co., Ltd.

London.—L.C.C.—The Wotan traction type lamps have been adopted for use on the L.C.C. tramcars, and a contract has been placed with Messrs. Siemens Bros. Dynamo Works, Ltd., to cover the total requirements for the ensuing twelve months. The number of lamps required will be approximately 150,000.

POPLAR.—B.C. Ferguson's Superheater, Ltd., £250. Superheater for Stirling boiler at generating station. Amount exclusive of pipe connections, valves, and alterations to existing pipes, estimated to cost an additional £50.

Spain.—The municipal authorities of Pastaria (Province of Guadalajara) recently invited tenders for the concession for the electric lighting of the town during a period of ten years. Only a single offer was received, and was accepted.

Willesden.—U.D.C. Watson, Marsh & Co., £46 10s. for installing electric light for Health Department.

THE 12½ PER CENT. AWARD.

THE members of the Incorporated Municipal Electrical Association have received from the hon. secretary, Mr. H. Faraday Proctor, a circular relating to the 12½ per cent. and other bonus awards, and to progress payments on contracts.

With reference to the Award made by the Chief Industrial Commissioner on January 7th, Mr. Proctor has received a communication from Sir George Askwith, showing that the 12½ per cent. bonus has to be paid to all plain time workers employed in the Association's undertakings, whether certified undertakings under the Munitions of War Act or otherwise. Considerable latitude is given as to the application of the Award to those other than plain time workers, and the Council is of opinion that, subject to local circumstances, the 12½ per cent., or some variation of this percentage, will have to be paid generally to other than the time workers, of course always excepting those skilled men who have already received the benefit under the 12½ per cent. Award of December last.

With regard to other bonus awards, the Awards of the Committee on Production are only binding upon the parties to an agreement which was come to between the Engineering Employers' Federation and certain Trade Unions, and other undertakings to which a special extending order is applied by the Ministry of Munitions.

Notwithstanding the fact that such Awards are not compulsory, it has been found expedient in a large number of undertakings to pay bonuses somewhat corresponding with the said Awards, and Mr. Proctor states that it is probably desirable that members should follow the practice in the district in which their undertakings are situated as regards the payment of any bonuses in addition to the 12½ per cent., which is compulsory.

The Council has agreed with the representatives of other associations that no payment in excess of 20s. per week, plus the 12½ per cent. bonus, should be made until the matter has been considered by a conference of the different associations, and urges members to comply with this agreement, with a view to avoiding the setting-up of any precedent in any part of the country which may affect the whole.

Referring to the applicability of the above awards and bonuses, Mr. Proctor draws attention to his circular letter of November 1st, 1917, relating to the payment of engineering assistants, and the recommendation "that, as a first step, the bonus awarded by the Committee on Production should be paid (where this has not already been paid) to all members of the staff," &c.

A Committee of the I.M.E.A. has in a forward state the consideration of the question of standardisation of payments to charge engineers, and hopes that information may be circulated at an early date. In the meantime, attention is drawn to the fact that some of the large engineering firms are paying the 12½ per cent. bonus to members of their staff receiving not more than £250 per annum, and bonuses from 12½ per cent. down to 10 per cent. on salaries up to £500 per annum.

As stated in Sir George Askwith's memorandum, this is a matter for the employers themselves to arrange, payments often being necessary if for no other reason than to maintain the status of officials in relation to those who are working under them.

A letter has been received from the Chief Industrial Commissioner to the effect that the "decision" does not apply to boys and youths (*i.e.*, employés under 18 years of age).

With regard to progress payments on contracts, this matter is receiving the attention of the Model General Conditions of Contracts Committee. As, however, no arrangements have been made, and no definite proposals have, as yet, been put forward, the Council of the I.M.E.A. suggests that no payments be made in respect of progress of works remaining on contractors' premises, unless a suitable *quid pro quo* be arranged.

Protected Rubber Gloves.—The *Revue Générale d'Electricité* describes a rubber glove manufactured by the Duquesne Light Co., of Pittsburg. This glove is composed of a sheet of rubber 1 mm. thick, covered and protected by a second glove of horse-hide. The gloves are tested by means of a device comprising a copper hand filled with water, which is placed in the glove, and an iron tank filled with water, in which the gloved hand is placed. A difference of potential of 10,000 volts is applied between the water in the hand and the water in the tank. Only the gloves which this test shows to be properly insulated are passed.

WAR ITEMS.

Exports to China.—In the "London Gazette" for January 18th there is a further list of persons and bodies in China to whom exports may be consigned.

Coal Shortage in Prague.—Prague and the whole of Bohemia are suffering from a serious coal shortage. The weather is severe, and there is a danger that Prague may be left without gas and electricity.—*Times.*

Danish Industries at a Standstill.—For a month, says a Copenhagen newspaper, Denmark has had no supplies from the Western countries, and her industries are coming to a standstill. More than one-fourth of the skilled workmen of the country are out of work, and from week to week thousands of workmen are added to the number of unemployed.—*Times.*

The Tramways of Leipzig.—The "Times" states that in Leipzig the number of tramway cars fit for service has fallen from 700 before the war to 105. The recent snowstorms put 58 out of service, and neither labour nor materials are available to repair them.

Coal Shortage in Germany.—A Reuter dispatch from Amsterdam, dated January 19th, says:—"Berlin is suffering from an enormous dislocation of traffic owing to the recent severe frost, which followed a heavy downfall of snow. A considerable number of the tramway services came to a standstill on Friday, and the entire motor omnibus traffic is also interrupted. The city underground railways are unable to cope with the passenger traffic. Railway communication to and from Berlin is likewise considerably interrupted, and a majority of the large provincial cities are cut off from rail communication with the interior."

Restricted Exports from America.—The Ministry of Munitions are drawing the attention of their contractors and agents to the consequentes of the system of restrictions on export and priority of orders, which the United States Government is bringing into operation for the purposes of the war. The result of such a system is that private firms desiring to secure export to this country from the United States of munitions or materials to be used directly or indirectly in the manufacture of munitions will find it increasingly difficult, if not impossible, to do so except either through, or with the direct assistance of, the Ministry of Munitions or other Government Department concerned.—*Daily Telegraph.*

Life in Petrograd.—The Petrograd correspondent of the *Times*, writing under date January 16th, says:—"The tramways have ceased running since Saturday for want of fuel, and this is a great inconvenience to the population, the tramways being the only means of communication. . . . The electric lighting is uncertain; on some days a full service is given, and on others whole districts are left in the dark. The supply of paraffin, which is used for cooking and lighting, has temporarily ceased owing to the chief depôts being snowed up."

Trading with the Enemy.—The "London Gazette" for January 18th contains further additions to the list of persons and bodies in the following countries with whom trading is prohibited:—Argentina, Paraguay and Uruguay, Brazil, Central America, Chile, Iceland and Faroe Islands, Liberia, Morocco, Netherlands, Netherland East Indies, Norway, Spain, and Venezuela.

Coal Famine in Germany.—The "Times" correspondent at Amsterdam says that the *Rheinisch-Westfälische Zeitung* gives prominence to the difficulties in obtaining coal, declaring that everyone is suffering from a great coal famine. Half a column is devoted to explaining why, while Germany has coal, a shortage is inevitable owing to difficulties of railway carriage and paralysis of water transport due to snow and ice. The journal says that the crisis has now reached its climax. The journal, speaking of the situation in South Germany, declares that difficulties are increasing daily, and the "distress there owing to lack of fuel is indescribable."

Exemption Applications.—At Radcliffe (Lancs.) Local Tribunal, an electrical engineer, aged 30, married, claimed exemption on the ground that it was essential in the national interest that his business should be maintained, particularly as the bulk of the work now being done was for works controlled by the Government, the remainder being for the export trade. Conditional exemption was agreed to.

Radcliffe Tribunal has granted conditional exemption to an electric fitter (33, Class A), the only man left capable of doing electrical work, and engaged on extensions, repairs, and maintenance of electrical installations at works, &c.

At Lewes, the Electric Supply Co. applied for renewed exemption for A. J. Cox (32, garrison duty abroad), engine fitter and cable jointer. Captain Selby Ash suggested that the case should be adjourned for the National Service authorities to try and find a substitute. The manager of the works (Mr. H. J. Williams) said that he did not think it would be possible to find a substitute, as the man was doing the work of three separate men at an ordinary station. Mr. Farncombe observed that an efficient substitute would have to be secured before the man was released, and the adjournment was agreed to.

At Ryde, the Isle of Wight Electric Light Co. appealed for P. G. Churchill (22), claimed to be in a certified occupation, and by agreement conditional exemption was conceded.

The West Sussex Appeal Court has dismissed an appeal by the National Service Representative against exemption until February 21st granted to a Brighton electrician (40, B 2), but the Court expressed the opinion that respondent should join the Volunteers.

Before the West Kent Appeal Court, exemption was sought by A. S. May (38, C 2), of Orpington, whose case had been put back for him to obtain work of national importance. He was stated to have become electrical engineer at the Ontario Military Hospital at Orpington, and three months were conceded.

At Folkestone, there was a review of the cases of Messrs. Cripps and Pain, switchboard attendants at the works of the Electricity Co. It was complained that they had not carried out the required number of drills with the Volunteers, Cripps not having put in any, and Pain only 11 out of a minimum of 22. Cripps said that the arrangement of hours, eight hours seven days a week, did not permit him to give the necessary time. Ald. F. Hall, for the company, said that the men were on work of national importance, and in a certified occupation. The staff at the works was very much depleted; 40 had left out of 90, and they must have efficient substitutes. The Tribunal respited the cases until February 10th to give the men an opportunity of fulfilling the Volunteer condition, the alternative being the withdrawal of exemption.

At Hastings, the Tramway Co. appealed for several of their staff. Mr. Webb, an electrical engineer (A 1), the only one in the power house with an electrical training, and left with a depleted staff, was granted conditional exemption. The chief clerk (29, A 1) was allowed four months, with the suggestion that someone should be trained to take his place; the depôt superintendent at Silverhill (39, C 1) was given three months; an overhead linesman (37, B 1) and his assistant (31, C 1), who does the cable jointing work, had conditional exemption renewed; a driver in the power house was granted conditional exemption; a car-body man was allowed a final two months; a brake examiner (23, B 1) received three months final; nine tramcar drivers were given from one to three months final; and three men, each in Class C, engaged at the depôts, were each allowed three months by consent of the Military.

IMPORT TRADE OF AUSTRALIA.

A REPORT on the position of the import trade of Australia in July, 1917, by Mr. G. T. MILNE, H.M. Trade Commissioner in the Commonwealth of Australia, has just been issued by the Board of Trade.* It has been prepared in place of the usual annual report by the Commissioner. Extracts are given below of such portions as will interest the electrical and allied trades.

Competition from the United States and Japan.—The strong position achieved by the United States in the Australian market has, of course, been rapidly enhanced by the war situation, but it would be altogether a mistake to disregard the fact that previous to the war that position was, year by year, becoming more assured. The branch of trade in which the effect of United States competition is most severely felt is in that of machinery, one of the most important groups comprised in America's total being electrical machinery.

Soon after the outbreak of war numbers of Japanese merchants sent travellers to study the Australian market, and the Japanese Government supplemented these efforts to increase trade by dispatching Commissioners. Both the official and non-official envoys displayed the greatest activity in securing samples of the goods most in demand, and, although the object in view was officially stated to be the supplying of such articles as were formerly imported from Germany, no opportunity was lost of securing orders for goods of any kind that could be successfully manufactured in Japan.

Japan's purchases from Australia have nevertheless been in excess of her sales, and neither her Government nor her manufacturers and merchants will be likely to relax efforts to balance the account by shipments of manufactured goods.

In common with the metal trades generally, there has naturally been a considerable decline in the value of imports of machinery. On the electrical side, British firms have managed to do a considerable amount of business, notwithstanding the many difficulties by which they are confronted. The elimination of the Allgemeine Elektricitäts Gesellschaft ("A.E.G."), whose competition was of the most formidable kind, has left the American manufacturer as our most serious competitor. Up to the present no electrical machinery of Japanese manufacture has been imported, with the exception of a few small motors. For some years a certain amount of electrical material has been imported from Sweden, notably telephonic apparatus, and, to a less extent, dynamos. A large Swedish concern has been giving greater attention to the Australian market of late, and has made arrangements for endeavouring to secure an increased share of the trade.

With regard to electrical appliances other than machinery, the imports of most of these lines show a falling off, but, while the elimination of German competition has tended to

* Cd. 8,841. Price 3d.

strengthen the hold on the market of American and other competitors, the British position cannot be regarded as having been unsatisfactory during the war period when all circumstances are taken into account. The trade in electroliers and brackets is comparatively unimportant, as many of these are made, or at least assembled, locally. In metal fittings, such as switches and lampholders, Japan has entered the market, but these products are not regarded with much favour, although low in price. In heating and cooking appliances, America holds the leading position, but the imports are small in amount, as some of these outfits are put up locally. The trade in wire-filament lamps is very large, and growing in common with other electrical lines, but no figures are available to indicate the value of the import trade. It is mostly shared by the United Kingdom, United States, and Holland. Although these lamps are manufactured in Japan, they do not appear to be exported to this market at present to any extent. The Customs duty on these lamps amounts to 20 per cent. *ad valorem* if manufactured in the United Kingdom, and to 25 per cent. if from other sources. The intention of the Legislature in conceding preference to goods of British manufacture has, however, in effect been negatived, because the wholesale selling price in Holland of the Dutch lamps, for example, on account of lower wages paid, is considerably lower than the wholesale selling price in the United Kingdom of the British lamp. It has been estimated, therefore, that while the duty on the Dutch lamp works out at from 2¼d. to 2¾d. each, that on the British lamp comes to as much as 4¼d. per lamp. On account of this disability, firms offering the British lamp to public bodies when tendering are placed at a disadvantage. Japan has done considerable business in electrical glassware (shades, &c.). In insulated cable and flexible cords, the Japanese makers do not, as yet, hold a strong position, but the quality of the goods submitted is stated to have improved, although it is still inferior to those of British firms.

With regard to insulators, the British position has, for a long time, been unsatisfactory, as in certain types of insulators British prices have been such as could not compete with Continental and Japanese makers. A considerable number of insulators are now being manufactured in Australia, and, where found to be satisfactory, these have a preference in contracts issued by the postal authorities. British manufacturers of electrical material are kept well informed of developments in the industry through their branches and representatives, while the British Electrical and Allied Manufacturers' Association, which has an Overseas Committee in Melbourne, is enabled to watch the trade as a whole.

Demand for Engineering Supplies.—A few remarks should be devoted to probable developments in which engineering supplies will be in demand, and to the representation of engineering firms. As in all new countries, there has been, and is likely to be, in Australia very large expenditure on works of a public, as well as of a private, kind demanding engineering plant and supplies.

Schemes for the extension of railways, the improvement of ports and harbours, water supply and sewerage, irrigation power supply (such as those of a hydro-electrical kind in Tasmania, and the development of the immense brown coal deposits in Victoria), held over owing to the war, will be undertaken, and the source whence these will be financed will determine to a large extent where the orders for plant will be placed. Road-making on a large scale is being recognised as one of the most urgent needs of the country.

The pronounced tendency of the State of Australia to control activities which in some countries are directed by the private capitalist is too well known to be dilated upon here, and there is every presumption that this policy will be continued and extended after the war. In the past, British engineering firms have been represented in Australia to a considerable extent by local firms with engineering experience, although in some cases by firms in which this has been lacking. British engineering firms cannot be reminded too often that, if they wish to supply plant and machinery to Government Departments and public bodies in Australia, it is practically essential that they should be locally represented either by a technical man who devotes his whole time to the interests of his firm, or by one or other of the numerous reputable firms in the country who are familiar with engineering work, and are in touch with the Government Departments. In the latter case, it is a good plan for the home firm to have one of its technical men on the staff of the of the Australian firm.

One important matter which should be kept in view is whether a given local firm, which expresses its readiness to undertake the representation of British engineering interests in the whole of Australia, is in reality qualified to do so. Instances could be cited, not only in respect of engineering representation, but in regard to agencies of every kind, where the agent can do justice to the interests of his principal in one or two States only, but in which he has made himself responsible for the whole of Australia. Provision against this kind of thing can only be secured by making the fullest possible investigation; indeed, it may be said that no really large and important agency appointment can, as a rule, be satisfactorily made without a visit to Australia by a partner or superior officer of the home firm or company, except in cases where the Australian firm has a London house, or where one of its partners periodically visits the United Kingdom. If there is one criticism which more than another is directed against British manufacturers in practically every branch of trade, it is the failure on their part to appreciate the value of the Australian market, and their consequent unwillingness to expend the time and money necessary to visit the market. This indifference or neglect has undoubtedly contributed to our loss of trade in some directions, and is in reality an expression of that tendency to rely on the buying houses already referred to.

Co-operative Selling Organisations.—In the re-organisation of the engineering and metal industries forced upon the United Kingdom by the war, it has become apparent that, if United Kingdom manufacturers are to meet successfully the strong competition in the markets of the world which is anticipated after the conclusion of hostilities, there must be a far greater degree of co-operation among the firms in a given branch of industry than there has been in the past, and there is already evidence that this is taking place. So much has been written about standardised and large-scale production, and the elimination of overlapping in production, that it is unnecessary to deal with this question here; it is rather the question of co-operative effort in connection with distribution in overseas markets that demands attention.

The recent formation by certain firms of machine-tool makers in the United Kingdom of a trade association which has in view the prevention of overlapping in production and co-operative selling arrangements in overseas markets will, it is hoped, be followed by other branches of industry. If each of the more important industries in the United Kingdom were organised in such a way that the association representative of that industry would act as a guardian of the interests of its members, and would, through its expert officers, systematically study the markets of the world for their benefit, the result would be of the greatest possible advantage to British trade. Let the officers of these associations pay a visit for a few months to the principal oversea markets, and work in co-operation with the resident British official representative of trade, and they will obtain information of such a kind, and be able to present it to those interested in such a form, as cannot at present either be obtained or presented by the official representative of trade who endeavours to keep himself informed on the whole range of the import trade. In saying this, it is not suggested that the individual manufacturers can afford to relax their efforts, but it must be obvious that a systematic investigation of the kind suggested, undertaken in the interests of an industry as a whole, will be productive of better results to British trade than the isolated and, in some cases, imperfectly conceived efforts of the individual firm.

FORTHCOMING EVENTS.

Physical Society of London.—Friday, January 25th. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Presidential address by Mr. C. V. Boys, F.R.S.

North-East Coast Institution of Engineers and Shipbuilders.—Saturday, January 26th. At Newcastle-on-Tyne. At 6 p.m. Address by the Right Hon. C. Addison, M.P., Minister of Reconstruction.

Royal Institution of Great Britain.—Saturday, January 26th. At 3 p.m. At Albemarle Street, Piccadilly, W. "The Chemical Action of Light" (Lecture II), by Prof. W. J. Pope, F.R.S.

Friday, February 1st. At 5.30 p.m. At Albemarle Street, W. 1. Lecture on "Gravitation and the Principle of Relativity," by Prof. A. S. Edington, F.R.S.

Royal Society of Arts. Monday, January 28th. At 4.30 p.m. At John Street, Adelphi, W.C.2. Cantor Lecture on "High Temperature Processes and Products," by Mr. C. R. Darling (Lecture II).

Institution of Electrical Engineers.—(Manchester Local Section.)—Tuesday, January 29th. At 7 p.m. At the Engineers' Club. Paper on "Telephone Exchange Transfers and their Organisation," by Mr. F. G. C. Baldwin.

NOTES.

The A.S.E.—It is stated that the membership of the Amalgamated Society of Engineers at the beginning of this year was approximately 272,000. At the end of 1911 it was 121,000.

Volunteer Notes.—LONDON ARMY TROOPS COMPANIES, VOLUNTEER ENGINEERS.—Headquarters, Balderton Street, Oxford Street, W. 1.

Orders for the week ending February 2nd, 1918, by Lieut.-Colonel C. B. Clay, V.D., Commanding.

Officer for the Week.—Second Lieut. F. Gaywood.

Monday, January 28th.—No. 3 Company, 6.30—8.30. Recruits' Drill, 6.30—8.30. Signalling Section, 6.30—8.30.

Tuesday, January 29th.—Musketry instruction for N.C.O.'s at 5.30. Lecture on "Demolitions," at 6.30. Physical Drill and Bayonet Fighting, 7.30.

Wednesday, January 30th.—No. 1 Company, Knotting, &c., 6.30—8.30. Musketry instruction for N.C.O.'s, at 6.30. Recruits' Drill, 6.30.

Thursday, January 31st.—No. 2 Company, Knotting, &c., 6—8. Recruits' Drill, 6.30—8.30. Signalling Section, 6.30—8.30. Ambulance Section, 6.30—8.30.

Friday, February 1st.—Musketry, 5.30—8.

Saturday, February 2nd.—Entrenchments, &c., for the whole corps, 2.45—4.45. Musketry instruction for N.C.O.'s, 4.45.

All drills will take place at Headquarters, unless otherwise stated.

(By order) MACLEOD YEARSLEY, *Capt. and Adjutant.*

The Alleged Discovery of a Substitute for Copper.—German industrial circles are very much interested in the discovery of a new alloy which, it is said, will replace copper for technical purposes. The new metal is said to have a greater density than copper and lower elongation, while being an excellent conductor of electricity. A certain number of tests have already been made on the alloy, and a representative of the A.E.G. is in negotiation with the inventor with a view to acquiring the patent rights. The A.E.G. will probably grant a licence to a large foundry at Lausanne to manufacture the substitute.

Lack of detailed information forbids us to comment with any approach to conviction on the matter, but we may point out that hitherto experience has indicated that any alloy of two metals may be expected to possess a higher resistivity than one of its constituents. Hence, while it would be reckless to deny the possibility of producing an alloy with high conductivity, we are very sceptical as to the reliability of the inventor's claim in this respect.

Women and Electricity.—When a woman is sulky and

will not speak	Exciter.
If she gets too excited	Controller.
If she talks too long	Interrupter.
If her way of thinking is not yours ...	Converter.
If she is willing to come half way ...	Meter.
If she will come all the way	Receiver.
If she wants to go further	Conductor.
If she would go still further	Dispatcher.
If she wants to be an angel	Transformer.
If you think she is unfaithful	Detector.
If she is unfaithful	Lever.
If she proves your fears are wrong ...	Compensator.
If she wants chocolates	Feeder.
If she sings wrong	Tuner.
If she is a poor cook	Discharger.
If she is wrong	Rectifier.
If she is cold to you	Heater.
If she gossips too much	Regulator.
If she becomes upset	Reverser.

—*Electrical Experimenter.*

The Electrolytic Refinement of Copper.—In the course of his Cantor Lectures on "Progress in the Metallurgy of Copper," reported in the *Journal of the Royal Society of Arts*, Prof. H. C. H. Carpenter gave the following account of the refineries at Raritan, near New York:—The metal arrives from Anaconda averaging from 99·3 to 99·8 per cent. of copper. It contains also about 80 oz. of silver and 0·5 of an ounce of gold per ton. The method of arranging the electrodes in the depositing tanks is that known as the parallel or multiple system, in which all the anodes in one tank are connected to one pole of the circuit, and the cathodes situated between them to the other. Each tank has thirty anodes and thirty cathodes, and there are three thousand tanks in all. In this way each tank constitutes one large anode and one large cathode, and the voltage as measured between any two neighbouring electrodes is the same. The system thus allows of the use of currents at low voltage, and the danger of short-circuiting is lessened. The tanks themselves are arranged in series. They are distributed on a series of descending levels, and the liquor flows from one set to the next by gravity through lead pipes, and is kept in circulation by pumps. The cathodes consist of thin plates of pure copper corresponding in size to the anodes, which are 2 ft. 6 in. × 3 ft. × 2 in. thick. The current density is about 12 amperes per square foot, the voltage is 0·2, and the temperature of the electrolyte 55° C. One anode stays in as long as three cathodes. The latter are allowed to grow until their thickness is $\frac{11}{100}$ in. They are then removed, otherwise nodulising occurs, and this sets up short circuits. The anodes last about one month, and are then taken back to the anode-casting furnace. From the sludge in the tanks are obtained gold, silver, platinum, palladium, selenium, and tellurium.

The electro-deposited copper, whose purity is from 99·95 to 99·98, still requires one more treatment. The metal, in spite of its high degree of purity, is not tough, nor is it in a shape suitable for industrial use. It is, therefore, given a final furnace-refining of the same character as that which preceded the electrolytic refining, and is cast into ingots. When intended for conductivity work the metal is cast into wire-bars of varied shape and size according to requirements. Some of these are 500 lb. in weight, and measure 7 ft. × 4½ in. square. Before casting, samples of copper are taken and drawn down into wire and tested for electrical and mechanical properties. The effect of this final operation is to reduce the purity of the copper, owing to the introduction of oxygen, to about 99·7 to 99·8 per cent.

In connection with certain important changes which were made in the Anaconda works in 1914-1915, the Cottrell process for agglomerating and collecting fine particles contained in gases moving at high velocity has been adopted for the recovery of mineral values from the flue dust passing out of the new roasters.

Above the roaster are installed four Cottrell units in a structure located over the main 25 ft. × 25 ft. flue. The units employed are of the so-called "box" type. Each contains 21 plates 20 ft. high and 24 ft. long, 11¾ in. apart. Each plate is made up of sheets of 20-in. corrugated iron, the axes of the corrugations being horizontal. Corrugated sheets are used in preference to flats on account of their stiffness. Between the plates are hung steel chains ½ in. thick over all. The gas flows upwards from the bottom, and returns to the flue by way of a common down-take, the distribution of the flow being controlled by butterfly dampers on the top of the unit. The voltage between the electrodes is about 50,000, and the total power consumed between 90 and 100 H.P. Somewhere about 800,000 cubic feet of gas per minute, at a temperature of 200° C., pass through the four units, though they were designed for only half this quantity. The dust recovered is about 70 tons per 24 hours from the treatment of 1,500 tons of concentrate. A new plant is soon to be installed, which will follow the present units somewhat closely in design.

At the mine of the Chile Exploration Co., situated at Chuquicamata, electrolytic copper of a high degree of purity is obtained from the ore in only three stages. The plant is designed for a capacity of 10,000 tons of average grade ore per day. The latter is crushed to about ½ in. mesh, and leached with sulphuric acid. The greater part of the chloride is eliminated by treatment in tube mills with metallic copper. The remaining copper is precipitated from solution by electrolysis, and the cathodes are melted into commercial bars. The cuprous chloride formed in the dechloridising drums is worked up into copper, either by smelting or by dissolving the chloride in salt and electrolysing, or by precipitating as cement copper with scrap-iron. In the original plant magnetite anodes were used in the electrolytic process. They proved very brittle, and numerous breakages occurred. A substitute which has proved satisfactory on the whole is duriron, a high silicon-iron alloy. It is not entirely unacted on, but from 15 to 20 times its weight of copper can be deposited before it is corroded away. Duriron anodes have an advantage over magnetite in their mechanical strength, but they have a much higher over-voltage, which is a decided disadvantage, and about 15 per cent. more electrical energy is required for the deposition of the same quantity of copper. The conductivity of the copper produced is from 100·5 to 101 per cent. Matthiessen's standard.

From start to finish the process is one of hydrometallurgy and pyrometallurgical processes—apart from one alternative method of working up the cuprous chloride—are entirely absent.

Electric Lorries and Petrol Economy.—We learn from New York that President Wilson is taking personal steps to bring about petrol economy without undue disturbance of transport interest, and has agreed that every encouragement shall be given to the continued output of electric lorries both for home trade and export to the United Kingdom. The U.S.A. Aeronautical Department has purchased the rotary engine division of the Long Island City factory of the General Vehicle Co. for £500,000, but the terms of the Government contract expressly protect the electric vehicle departments, and every facility will be provided for their increased production if required. It is understood that the present depletion of transport in the United Kingdom largely accounted for the decision not to interfere with the General Vehicle Co.'s export trade.

Breaking up Engine Foundations.—Quicklime, when wet, develops an enormous expansive force that acts slowly and almost irrisistibly, and has long invited use for mechanical purposes. Successful efforts to utilise this force have been noted in a recent issue of *Rock Products*, which describes its efficient use in breaking up heavy brick masonary. Several 12 ft. by 20 ft. piers, 12 ft. high, were situated between similar foundation piers for engines in operation, and it was necessary to remove them without injuring the machinery. Blasting was therefore inadmissible, and hand-cutting and breaking too slow and expensive. The work was accomplished by drilling 3 in. vertical holes 3 ft. deep and 3 ft. apart in both directions over the entire area of the piers, and filling them within 6 in. of the top with freshed slaked lime, in pieces ½ in. to 1½ in. wide. As soon as the lime was thoroughly wet the tops of the holes were filled with brick drilling well tamped, and in about ten minutes cracks started in every direction, and the entire top of the foundation pier was broken into 3-ft. cubes.—*Journal of the Royal Society of Arts.*

Medals for Motormen.—The Medal of the British Empire for courage has been awarded to Motorman J. F. Sams and Conductress E. Anger, of the Southend-on-Sea Corporation tramways, who remained at their posts during the German air raid on the town on August 12th.

Electricity in Agriculture.—Some interesting experiments in connection with the application of electricity to crop culture are being conducted at Liverpool under the direction of Mr. J. A. Brodie, the city engineer, and Mr. Harold Dickinson, the city electrical engineer. The experiments are being carried out at Calderstones Park, where a small installation has been set up in order to test an area of about an acre. Two patches of land have been placed under observation, one being under electrical treatment and the other left to Nature. Each plot has been planted with similar seed, including oats and barley, and the results are being carefully noted. So far the periodical measurements show that the crops under electrical treatment are progressing more rapidly than the untreated, but the trials are not yet sufficiently advanced to afford definite results.

The Siemens Shares.—In reply to a question, Sir Albert Stanley, President of the Board of Trade, states that the shares in Siemens Brothers & Co., Ltd., vested in the Public Trustee, have been sold to British-born subjects. No company has been formed for the purpose of purchasing the shares. One of the conditions of the sale is that the articles of association should be altered in such a manner as to ensure that the control of the company will in future be vested in British subjects, and the Public Trustee received assurances as to the continuance of the business.

Institution and Lecture Notes.—Diesel Engine Users' Association.—At the December meeting of the Association, Mr. Napier Prentice, engineer and secretary to the Suffolk Electricity Supply Co., Ltd., was elected as President in succession to Mr. Porter, and Messrs J. E. Edgecombe, Kingston-upon-Thames, and A. W. Money, Chiswick, were elected as the new members of the General Committee. Mr. Percy Still was re-elected as honorary secretary, and made a statement as to the position of the Association and the work dealt with during the year 1917. The total membership of the Association now numbers 88, representing a total Diesel engine horse-power of 52,451. The new class of "subscribers," which was formed towards the end of the year 1916, now numbered 59, being an increase of 40 during the year. The abnormal increase in the price of all classes of fuel oil and the difficulties of obtaining regular and suitable supplies, due to the conditions brought about by the war, had received the attention of the Committee. The control of tar oil supplies by the Ministry of Munitions, and the system of using licences to sellers and purchasers, led to communications and interviews with the Controller of Mineral Oil Supplies, which had no doubt been productive of amelioration in their position. Having devoted a considerable amount of attention to encouraging the production in this country of suitable tar oils for use as Diesel engine fuel, under the impression that the economical use of such fuel would be in the national interest as well as being beneficial to the industry, the Association felt that their claim to be allowed the comparatively small proportion of tar oil fuel necessary for the continuity of the working of their members' undertakings was entitled to some consideration on the part of the authorities. Their action in this matter had certainly led to a better understanding of the situation by the departments concerned. The action of the Association in taking up the subject of the granting of better terms in regard to the allowance for depreciation of Diesel engines for income-tax assessment had led to a very important concession being made by the Inland Revenue authorities. The rate allowed for this depreciation had now been increased from 5 per cent. to 10 per cent., and this increased allowance would remain in force for three years after the cessation of the war. The standard policy of insurance against breakdown, which had been adopted by the Association some time back had been fully considered, and a new clause had been agreed to providing for reference to a Standing Committee of the Association of any disagreement which might arise in the interpretation of the terms of the policy.

Liverpool Engineering Society.—On Wednesday, January 23rd, Mr. Harold Walker read a paper on "Steam Boilers: their Design and Construction."

The Institute of Metals.—The annual general meeting will be held in London on March 13th and 14th. The Presidential Address will be delivered and several papers read and discussed on March 13th, whilst further papers, including the Fourth Corrosion Report, will be read on March 14th.

Institution of Electrical Engineers.—The arrangements for the second half of the current session include the following items:—February 7th, Kelvin Lecture, by Prof. M. Maclean, on "Kelvin as a Teacher"; February 21st, Dr. C. C. Garrard, on "Switchgear Standardisation"; March 7th, Mr. E. B. Wedmore, on "The Control of Large Amounts of Power"; March 21st, Dr. S. F. Barclay, on "The Mechanical Design and Specification of the Turbo-Alternator Rotor"; April 11th (joint meeting with the Electrical Section of the Royal Society of Medicine), papers on "Medical Electricity," with an exhibition of apparatus; April 25th, Mr. E. C. McKinnon, on "Large Batteries for Power Purposes"; May 9th, discussion on "A British Electrical Proving House," with an introductory paper by Mr. C. Turnbull; May 23rd, "Some Transient Phenomena in Electrical Supply Systems"; May 30th, annual general meeting.

At the meetings of the LOCAL SECTIONS the same subjects will be discussed.

Inquiries.—Detailed information concerning the "Wilson" process of electric welding is asked for.

Munition Workers' Bonuses.—An official announcement issued on Wednesday last stated that the Government had had under consideration questions that had arisen in regard to classes of workmen claiming the bonus to munition workers. After careful consideration of the advice of the Committee on Production, and of the whole position, the War Cabinet had decided to adopt the following as a settlement of claims:—

1. The 12½ per cent. has been given to workmen employed on munition work, and paid as plain-time workers in engineering shops, boiler shops, foundries, shipbuilding and ship repairing establishments, iron and steel trades, electricity generating stations and electrical contracting trades, nut and bolt trade, brass foundries and brass works, bridge building and constructional engineering, hollow-ware trade, spring-making works, hot-stamping works, tube works, and wagon-building works.

2. As from the beginning of the first full pay week which followed January 1st a bonus of 7½ per cent. on their earnings shall be paid to all workmen of 21 years of age and over employed in establishments or trades (other than the iron and steel trades), and engaged on munitions work who are piece workers, or are paid on a premium bonus system or any mixed system of time and piece or any system of payment by results, including men working at augmented time rates fixed in lieu of piece rates, or by reference to results or to output of work.

3. The 7½ per cent. bonus shall be paid as an addition to any other bonus or war advances. No workman shall receive the 7½ per cent. bonus who has already received in some other form some equivalent consideration for the 12½ per cent. bonus. Where payment has been made to workmen pending the general consideration by the Government of the position of men paid by results, the amount shall merge in the 7½ per cent. bonus now authorised.

4. A special conference shall be called of employers and Trade Unions concerned in the iron and steel trades to consider the form in which this bonus shall be applied.

5. Any claims to participate in the 7½ per cent. bonus shall be settled by the Committee on Production.

THE 12½ PER CENT. BONUS.—The members of the Committee on Production have been appointed by the Minister of Munitions as a Special Arbitration Tribunal (Section 1 (2) Munitions of War Act, 1917) to deal with differences arising on the 12½ per cent. Order referred to the Tribunal for decision by the Ministry of Munitions.—*Times.*

The Scottish M.E.A.—With a view to safeguarding the interests of the smaller municipal electrical undertakings in connection with future developments, the Scottish Municipal Electrical Association has been formed, with Councillor M'Callum (Greenock) as chairman and Mr. W. C. Bexon (burgh electrical engineer, Kilmarnock) as secretary.

Fatalities.—An inquiry was held on 14th inst., at Blaydon-on-Tyne, into the death of Henry P. Poyzer, aged 17 years, an incline-braker at Blaydon Main Colliery. Herbert White stated that Poyzer and he were resting in the mine on the preceding Friday by keeping hold of a metal pipe containing electric cables, when they received a shock. Poyzer was killed and witness was rendered unconscious. William Blythe, a shifter, said he pulled Poyzer off the pipe, but then fainted, and Edward Richardson said he pulled White off the pipe. W. G. Armstrong, a fore-overman, used artificial respiration upon Poyzer. The jury found that Poyzer had been accidentally killed through having improperly taken hold of a steel conduit pipe containing live electric cables, thereby causing the ends of the cables to come into contact and inflict a severe electric shock.

Appointments Vacant.—Shift engineer (£3 +), for the Borough of South Shields electricity works; shift engineer (45s. +), and engine driver (35s. +), for the Borough of Tunbridge Wells electricity department; wireman for the Wolverhampton Corporation electricity supply department; wireman for the Rochdale Union. See our advertising pages to-day.

Midland Power Station Engineers.—On Thursday, February 7th, at 7.30 p.m., at the White Horse Hotel, Congreve Street, Birmingham, the annual meeting of the Midland Electric Power Supply Engineers' Association will be held. The subjects on the agenda are: Address by Chairman; alteration of name of association; future of association, propaganda, &c., and existing scales of remuneration.

America's Electrical Christmas.—Wide-spread reports indicate the success of the nation-wide "America's Electrical Christmas" campaign, conducted under the general direction of the Society for Electrical Development. Unprecedented sales activity in all parts of the country, particularly by contractor-dealers, resulted in a truly electrical Christmas. All of the advertising and sales efforts were built around the suitability of electrical appliances as holiday gifts. The Christmas shopper this year looked for useful presents, and the advertising by electrical interests directed attention to the electric shop. Moreover, this year, more than ever before, men in the industry took their own advice and gave electrical presents.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The salary of MR. ERNEST HOLT, manager of the Ashton-under-Lyne Corporation Tramways, has been advanced £50 per annum to £310.

MR. THOMAS D'ARCY NASSAU, engineer and manager to the County of Dorset Electric Supply Co., Ltd. (and to its associated companies, the Swanage Co., Lyme Regis Co., and Blandford Co.), has been released by the directors of the companies for service with the Army, and has been appointed to a Commission in the R.F.C.

The salary of MR. W. B. SMITH, chief assistant engineer in the Greenock Corporation Electricity Department, has been advanced by £75 per annum.

MR. S. A. RUSSELL has been appointed shift engineer at Stuart Street electricity station, Manchester, at a commencing salary of £220.

MR. A. L. LUNN, a senior shift engineer, has been appointed turbine house superintendent at Stuart Street, Manchester, at a commencing salary of £275, rising to £300.

Holmfirth U.D.C. has appointed MR. T. FRANCE, of Netherton, as an assistant engineer at the electricity works.

General.—After 25 years' service with the Worthington Pump Co., latterly as their resident director at the Newark-on-Trent works, MR. F. B. JACK has resigned, to take up an important post at the Sheaf Works of Messrs. Ruston, Proctor & Co., Lincoln. He was entertained by the members of the staff, on Friday,

January 18th, at the Holborn Restaurant, and a presentation of a handsome writing bureau, with fittings suitably inscribed, was made by Mr. J. N. Boot, on their behalf. The continuous growth and development of the company was effectively described by Mr. E. W. Husted, in which Mr. Jack had rendered the most loyal and hearty co-operation, and, while general regret was expressed at the severance of such a long association, the best wishes were heartily given for his future success with the company he had joined.

The Technical Education Sub-Committee of the Birmingham Education Committee recommends the appointment of MR. G. A. PERRY as temporary Assistant Workshop Instructor for Electrical Trades Classes at the Municipal Technical School, at £193 per annum, plus £15 war allowance.

CAPT. JAMES CALDWELL, M.I.E.E., R.E., of Messrs. James E. Caldwell, Glasgow, has recently been appointed Deputy Assistant Director of Materials and Priority at the Admiralty. Originally an officer in the Argyle and Sutherland Highlanders, he was afterwards on the headquarters' instructional staff. Later he was attached to the Royal Engineers to supervise the erection of electrical plant, and was afterwards engaged with the military railways section at the War Office.

We desire to congratulate MR. G. E. CHADWYCK-HEALEY, one of the proprietors of the *Engineer*, on his appointment by the Admiralty to be vice-chairman of the Shipbuilding Council and Assistant to the Controller.

Roll of Honour.—TEMPORARY MAJOR GEORGE CLEMENT MILNES, K.O. Royal Lancaster Regiment (who prior to the war was electrical engineer at Lancaster), gained his Military Cross "for conspicuous gallantry and devotion to duty during a period of several days under heavy shell fire." After standing in water over 24 hours, some of his men showed signs of wavering, whereupon he ran along the entire battalion front, rallied the men, reorganised the line, and did a great deal by his personal example to save what would have become a bad situation.

LANCE-CORPORAL F. SHACKLETON, Traffic Control Unit, who was on the staff of the Oldham Corporation tramways, has been awarded the Military Medal for bravery in dealing with transports under heavy shell fire.

LANCE-CORPORAL F. E. WYRE, Worcestershire Regiment, who has fallen in action, was with Messrs. Belliss & Morcom, Ltd., Birmingham.

PRIVATE B. HOLMES, Royal Warwickshire Regiment, who was on the staff of Messrs. Willans & Robinson, Ltd., Rugby, is reported wounded and missing since November 20th last.

SERGEANT WM. BAKER, R.E., who has been awarded the D.C.M., was engaged in the telegraph construction department of the Midland Railway Co. at Derby.

PRIVATE WALTER CHURCH, London Regiment, who has died of wounds received in action, was with Accumulators, Ltd., of Woking.

PRIVATE R. C. WHEWELL, who enlisted in May, 1915, from the Outwood station of the Lancashire Electric Power Co., and who already possesses the Distinguished Conduct and Military Medals, has been recommended for a further honour for gallant conduct.

PRIVATE WALTER FELL, Northumberland Fusiliers, who was reported missing in December last, and is now a prisoner of war in Germany, was employed at the Halifax electricity works.

PRIVATE H. J. BISHOP, the Buffs, formerly in the instrument department of the India-Rubber Co., Silvertown, was killed in action in France on November 20th, 1917, aged 19 years.

SERGEANT A. DUNCAN, R.E., who has been mentioned in dispatches, was on the staff of the Harrogate Corporation electricity department.

SERGEANT H. R. EASTWOOD, Duke of Wellington Regiment, who has been awarded the Military Medal for bravery at the Battle of Cambrai, was employed by the Yorkshire Electric Power Co.

The Military Medal has been awarded to PIONEER G. STEWART, Irish Brigade, for devotion to duty in holding the lines of communication under shell fire. Before joining the Army he was employed by Mr. Edward Dewhurst, electrical engineer, Preston.

PRIVATE JOHN HELSBY, King's (Liverpool) Regiment, wounded and in hospital in Worcestershire, was formerly employed by the B.I. and Helsby Cables, Ltd., Prescot.

MAJOR J. L. PARTINGTON, Royal Engineers, who has been mentioned in dispatches, belongs to Norton, Worcestershire. On the declaration of war he returned from South America, where he was an electrical signalling engineer.

The Stafford Gas and Electricity Committee this week presented a gold watch to CORPORAL HOLMES, a Corporation employé, in recognition of the award to him of the Military Medal.

We regret to learn that SERGEANT-MAJOR FERNAND DELEBECQUE, R.E., has been killed on the French Front. He was a brother of Mr. V. Delebecque, of the Walsall Electrical Co., Ltd. As a lad he was employed in the test-room of the Langdon-Davies Motor Co. He served his conscription in the French Army as Brigadier in the 4th Hussars, and had been in the Royal Engineers for more than 20 years. He was stationed at Mauritius and Gibraltar. At the latter place he was P.M. of the Calpe Lodge of Freemasons and a Past Principal of a Chapter there.

Obituary.—MR. J. S. SELLON.—We regret to learn of the death, which occurred in London, on Friday last, of Mr. John Scudamore Sellon. The deceased gentleman was 81 years of age. At an early age he joined the business house of Johnson, Matthey & Co., assayers and the refiners to the Bank of England and the Royal Mint, metallurgists, &c., founded by his uncle, Percival Norton Johnson, 1822. He played a prominent part in the researches and industrial developments connected with the platinum and other groups of rarer metals with which the name of his firm is associated. Towards the end of last century he also took an active share, both as to technical discovery and industrial development, in electrical engineering, being associated with Faure, Brush, Swan, Lane-Fox, Volckmar, and others in their early work in lighting and storage. In the early days of his connection with electrical matters, Mr. Sellon was a frequent visitor at the offices of the ELECTRICAL REVIEW, where he consulted the editors upon various interesting points.

The death occurred, on January 6th, at Negapatam, India, of MR. WM. FREDK. GILLOTT, loco. electrical engineer to the South Indian Railway Co. He was 40 years of age, and belonged to Sheffield.

SIR J. WOLFE BARRY.—We regret to learn of the death, which occurred on Tuesday in London, of Sir John Wolfe Barry, the renowned engineer. His connection with the railway electrification experiments of 1899, between Earl's Court and Kensington, will be within our readers' recollection. His pioneering work in engineering standardisation, and his service on Government Commissions respecting tube railway vibration, London street traffic and other matters, are parts of a life full of public work chiefly connected with engineering. Sir John was for many years chairman of the Eastern and Eastern Extension Telegraph Companies. He was 81 years of age.

NEW COMPANIES REGISTERED.

Adams Bros. (Longton), Ltd. (149,322).—Private company. Registered January 5th. Capital, £1,000 in £1 shares. To take over the business of electrical engineers, merchants, manufacturers of and dealers in electric, magnetic, telegraphic, telephonic, and other appliances formerly carried on by R. Adams, as Adams Bros., at Ford Street, Longton, Stoke-on-Trent. The subscribers (each with one share) are:—A. Brier, 102, Trentham Road, Longton, electrical engineer; T. O. Hayes, 39, Stoke Road, Longton, incorporated accountant. The first directors are to be appointed by the subscribers. Solicitor: S. Hayes, 13, Albion Street, Hanley, Stoke-on-Trent.

Brimington Electric Supply Co., Ltd. (149,377).—Registered January 15th. Capital, £2,000 in £1 shares. To carry on at Brimington and elsewhere in Derby the business of an electric lighting and supply company, &c. The subscribers (each with one share) are:—H. Phipps, Brimington, Chesterfield, gentleman; W. T. G. Burr, Brimington, Chesterfield, gentleman; H. J. Martin, Brimington, Chesterfield, moulder; H. H. Beresford, Cromwell Road, Chesterfield, assistant general manager of Staveley Coal & Iron Co.; C. E. Tissington, Brimington, Chesterfield, electrical engineer; R. Wharton, Brimington, Chesterfield, foreman smith; J. T. Frost, Brimington, Chesterfield, chief accountant clerk. Minimum cash subscription, £100. The first directors are: H. Phipps, H. H. Beresford, C. E. Tissington, and R. Wharton. Solicitors: Jones & Middleton, Chesterfield.

Harlow Remedies, Ltd. (149,406).—Private company. Registered January 18th. Capital, £3,000 in £1 shares (2,000 pref.). To manufacture and deal in medical and hygienic specialities, to establish hydros, and other institutions for the administration of electrical and other treatment, &c. The subscribers (each with one share) are:—W. Harlow Davis, M.D. (of U.S.A.), 2, West Bolton Gardens, S.W. 5; W. C. Goulding, 49, Finsbury Pavement, E.C. 2, solicitor. The first directors are: W. Harlow Davis, M.D., and W. C. Goulding (both permanent). W. Harlow Davis is managing director. Registered office: 2, West Bolton Gardens, S.W. 5.

Multiple Fuses, Ltd. (149,397).—Private company. Registered January 17th. Capital, £1,100 in £1 shares. Electrical engineers and contractors, suppliers of electricity, manufacturers of and dealers in electric, magnetic, and galvanic apparatus, rubber, rubber substitutes, asbestos, gutta-percha, silk, cotton wool, linen, thread, fibre, flax, hemp, jute, paper, papier maché, canvas, and other fabrics, insulating and other materials, &c. The subscribers (each with one share) are:—E. S. Conradi, 6-8, Rosebery Avenue, E.C., electrical engineer; J. F. Conradi, 6-8, Rosebery Avenue, E.C., electrical engineer. The first directors are: E. S. Conradi and J. F. Conradi. Registered office: 6-8, Rosebery Avenue, E.C. 1.

Nicholson Bros., Ltd. (149,370).—Private company. Registered January 12th. Capital, £10,000 in £1 shares. To take over the business of general, motor, and marine engineers and repairers carried on at Great Grimsby and elsewhere by Nicholson Bros., also to carry on the business of manufacturers of and dealers in, and owners of, electric generating plants, motor-driven hoists, winches, and lifts, complete mobile electric welding plants, aircraft, hangars, garages, sheds, aerodromes, floating workshops, &c. The subscribers (each with one share) are: C. F. Nicholson, 5, Westbourne, Terrace, Great Grimsby, engineer; J. W. Nicholson, St. Clair, Lambert Road, Grimsby. Managing director: C. F. Nicholson. Registered office: "Nibromo" Engineering Works, Roberts Street, Great Grimsby.

Basebe, Sadler & Co., Ltd. (149,362).—Private company. Registered January 11th. Capital, £7,000 in £1 shares. To enter into an agreement with A. C. Basebe and J. Sadler (trading as Basebe, Sadler & Co.), and to carry on the business of electrical and mechanical engineers and contractors, founders, smiths, machinists, tool makers, brass founders, metal workers, boiler makers, &c. The subscribers (each with one share) are:—A. C. Basebe, 106, Bingham Road, Croydon, engineer; J. Sadler, 51, Morland Road, Croydon, engineer. The first directors are: A. C. Basebe and J. Sadler. Registered office: 49, Goschen Buildings, Henrietta Street, W.C. 2.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Coatbridge & Airdrie Electric Supply Co., Ltd.—Further charge on the company's property, present and future, including the Coatbridge undertaking and the Airdrie undertaking, and uncalled capital, dated December 20th, 1917 (supplemental to charge of October 17th, 1906, created by the Scottish House-to-House Electricity Co., Ltd. the company's predecessor in title), securing £2,000. Holders: County of London Electric Supply Co., Ltd.

Stothert & Pitt, Ltd. (74,218).—Capital, £250,000 in 150,000 ord. and 100,000 pref. shares of £1 each. Return dated December 5th, 1917, 121,750 ord. and 71,350 pref. shares taken up; £47,350 paid; £145,750 considered as paid. Mortgages and charges: £25,000 first debs. and £30,000 second ditto (the latter issued as part of £50,000 registered).

Allen, West & Co., Ltd. (108,870).—Capital, £30,000 in £1 shares. Return dated December 17th, 1917. 28,472 shares taken up; £28,472 paid. Mortgages and charges: £20,000.

Perfect Burglar Alarm Co., Ltd. (112,522).—Formerly known as "Lichtenfeld Burglar Alarm Co., Ltd." Re-named January 30th, 1915. Capital, £4,000 in 1,000 pref. and 3,000 ord. shares of £1 each. Return dated December 5th, 1917. 230 pref. and 1,710 ord. shares taken up; £1 per share called up on 1,210 ord., and 15s. per share on 230 pref.; £500 considered as paid on 500 ord. Mortgages and charges: Nil. Directors: J. H. R. Bright and E. Maitland (both British by birth), and Siegmund Lichfield (formerly Lichtenfeld), naturalised British, of German origin.

J. B. Saunders & Co., Ltd. (112,037).—Capital, £20,000 in 6,000 "A" and 14,000 "B" shares of £1 each. Return dated December 6th, 1917. 6,000 "A" and 12,000 "B" shares taken up; £18,000 considered as paid. Mortgages and charges: Nil.

Foster Construction Co., Ltd.—Charge on moneys due under certain Government contracts for mine sinkers and steelwork, to secure all moneys due or to become due from the company to London and South-Western Bank, Ltd.

Kalgoorlie Electric Power & Lighting Co., Ltd. (91,219).—Capital, £225,000 in 175,000 pref. shares of £1 each, and 100,000 ord. shares of 10s. each. Return dated June 7th, 1917 (filed November 13th). 150,000 pref. and 100,000 ord. shares taken up; £3 10s. paid on seven ord. shares; £199,996 10s. considered as paid on the remainder. Mortgages and charges: £61,200.

Halifax & Bermudas Cable Co., Ltd. (28,972).—Capital, £50,000 in £5 shares. Return dated October 11th, 1917. All shares taken up; £50,000 paid. Mortgages and charges: Nil.

Nairobi Electric Power & Lighting Co., Ltd. (87,728).—Capital, £50,000 in £1 shares. Return dated December 20th, 1917. 34,050 shares taken up; £30,050 paid; £4,000 considered as paid. Mortgages and charges: £20,000.

Laing, Wharton, Ltd.—Mortgage debentures dated January 4th, 1918, to secure £700, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: Minister of Munitions.

Musselburgh and District Electric Light & Traction Co., Ltd.—Memorandum of satisfaction to the extent of £800 on December 14th, 1917, of charges dated 1905-9, securing £90,000, has been filed.

CITY NOTES.

Melbourne Electric Supply Co., Ltd.

The report is now issued for the year ended August, 1917. With a view to providing for the essential capital requirements of the company during the next two or three years a favourable arrangement was concluded in March last with Messrs. Higginson & Co., of London, for the sale to Messrs. Lee, Higginson & Co., of Boston, of $1,250,000 five-year 6 per cent. general mortgage convertible gold bonds, for distribution amongst investors in the United States. The proceeds of these bonds were duly received. Further expenditure at Melbourne during the year was £114,756, and at Geelong £4,798. The gross profit from the Melbourne and Geelong undertakings was £151,304, as against £143,315 in the preceding year, an increase of 5½ per cent. After providing for debenture sinking funds, putting £10,000 to reserve, putting £20,000 to reserve on account of income-tax and excess profits duty, &c., and writing off certain sums from bond issue cost, sundry items of plant, &c., 7 per cent. is paid on the preference shares and 10 per cent. on the ordinary, free of British income-tax, leaving £10,672, plus £62,144 brought forward, making £72,817 to be carried forward, subject to any further demands in respect of income-tax and excess profits duty. Notwithstanding the increasing difficulty of obtaining plant and materials, and the rising cost of fuel and labour, the business continues to expand. The number of consumers at Melbourne increased from 27,713 to 32,142; lighting from 23,901 KW. to 27,583 KW.; motors from 20,106 H.P. to 23,718 H.P.; units sold from 23,902,084 to 28,395,000; and the gross profit from £131,673 to £141,114. At Geelong the number of consumers increased from 2,573 to 2,843; lighting from 2,468 KW. to 2,643 KW.; motors decreased from 2,314 H.P. to 2,294 H.P.; and units sold fell from 1,519,944 to 1,505,941; and the gross profit from £11,641 to £10,191. The increase in consumers connected at Melbourne was 16 per cent., in power supply 17 per cent., in total connections 16 per cent., in units sold 19 per cent., and in gross revenue 17 per cent.

Marconi's Wireless Telegraph Co., Ltd.

The company has issued a circular to the shareholders stating that the protracted negotiations, with a view to a settlement being arrived at with the Post Office, in respect of the damages to be paid to the company in consequence of the repudiation on December 30th, 1914, of the Imperial contract, have not resulted in producing such an offer as the directors could feel justified in accepting. The proceedings in the High Courts, under the petition of right, have therefore been resumed, and it is hoped that the case will be heard early in the present sittings. With regard to remuneration for the services rendered by the company, and compensation in respect of the company's wireless stations, after their having performed invaluable services for three years, occasioning substantial disbursements, an offer was submitted on August 8th last to the company to cover both remuneration and compensation which the directors could only regard as inadequate and unreasonable. Before the end of last summer the company were given to understand that a new offer was about to be submitted. None has, however, yet been received, and the company are informed that it cannot be made pending the advice of the Law Officers. Without taking into account, however, the considerable sums which are estimated to be due to the company from the Government, the business of the past year has been satisfactory, and the directors feel justified in declaring the 7 per cent. preferential dividend upon the cumulative participating preference shares, and an interim dividend of 5 per cent. on the ordinary shares.

Adelaide Electric Supply Co., Ltd.

The report for the year ended August, 1917, shows that £40,628 was spent on capital account. The gross revenue amounted to £154,451, an increase of 13 per cent. After paying expenses, providing for debenture stock service fund, allocating £5,000 to reserve on account of income-tax and excess profits duty, 6 per cent. is paid on the preference and 12 per cent. on the ordinary shares, free of British income-tax, and £1,640 remains, plus £9,161 brought forward, leaving £10,800 to be carried forward subject to any further demands in respect of income-tax and excess profits duty. The number of consumers increased from 17,732 to 19,590; lighting from 13,360 KW. to 14,420 KW.; motors from 9,287 H.P. to 10,221 H.P.; total connections from 22,647 KW. to 24,641 KW.; and units sold from 8,388,345 to 9,330,495. The consumers increased by 10 per cent., power supply by 10 per cent., total connections by 9 per cent., total units sold by 11 per cent., and the gross revenue by 13 per cent.

The Siemens and Schuckert Companies.

The annual reports of the directors of this group of companies for the year 1916-17 are extremely brief. That of the Siemens-Schuckert Works refers to the increased requirements manifested by the Army and Navy, and the growing importance of the electrical transmission of power. The substitutes introduced for raw materials, which are scarce, were further improved, and the production was developed. In this connection it is stated that the use of aluminium in place of copper will continue after the war, and substantially influence the necessity for obtaining copper from America. The company's dividend, as previously reported, is 10 per cent., as in each of the two preceding years. In the case of the Siemens & Halske Co., the directors report that the works were chiefly engaged on electrical work for the Army and Navy, directly and indirectly, although the electrode and benzine motor works were also very active. The demand exceeded the company's capacity, and the orders on hand showed a considerable increase. The report further mentions that difficulties of working exist, and also in connection with the supply of necessaries to the workers. As recently announced, the dividend is 12 per cent., as in the previous year. The report of the Elektrizitats Gesellschaft (late Schuckert), of Nuremberg, states that the company's forces were fully occupied with preparations for activity after the war, special mention being made of the Bavarian water-power community, to which reference was made in this journal a few weeks ago. The net profits of £375,000, as compared with £403,000 in 1915-16, permit of the payment of a dividend of 8 per cent., as in the previous 12 months.

Yorkshire Electric Power Co.—This company has prepared a Bill for Parliamentary sanction to make further provisions with respect to the supply of electrical energy. The preamble, according to the *Financial Times*, states that since the company was incorporated in 1901 powers have from time to time been conferred upon local authorities to supply electrical energy within the company's area of supply, but outside the jurisdiction of such authorities, and it would be of public advantage that the generation of electrical energy should be concentrated. The Bill therefore proposes to enact that "if any local authority, company, body or person become empowered after January 1st, 1918, to supply electrical energy in any district within the area of supply of the company such undertakers shall take from the company all the electrical energy required by them for distribution." The terms and conditions are to be agreed, or failing agreement are to be determined by the Board of Trade. Provision is also made in the Bill for the constitution of joint committees and joint boards for the exercise "of all or any of the powers of the company and of any local authority" with reference to the generation and supply of electrical energy.

Anglo-American Telegraph Co., Ltd.—Balance dividends of £1 10s. per cent. upon the ordinary consolidated stock, and of £1 10s. per cent. upon the preferred stock, both less tax at 5s., and a first and final dividend of £1 10s. per cent. upon the deferred stock, less tax at 5s. With those already paid, the dividends will thus amount to £3 15s. per cent. upon the ordinary consolidated stock, 6 per cent. on the preferred stock, and £1 10s. per cent. on the deferred stock for the year 1917.

Gandy Belt Manufacturing Co., Ltd.—The directors are capitalising part of the reserve fund, and are distributing 37,500 new ordinary shares of £1 each in the proportion of one share for every two held. The preference dividend is to be increased from 5½ per cent. to 6 per cent.

Sao Paulo Tramway, Light & Power Co.—Dividend of 2½ per cent. on the common stock.

Companies Struck off the Register.—The following have been struck off the register and are dissolved :—

Acton Battery Co., Ltd.
Electrical Sales Promotion, Ltd
London Battery & Manufacturing Co., Ltd.
Mies' Electrical & Chemical Culture, Ltd.
Photo-Telegraph & Cable Co., Ltd.
Scandinavian Water Power & Paper Mills, Ltd.
United Cablegram Co. of France, Ltd.

The following will be struck off within three months unless cause is shown to the contrary :—

Bleichert's Aerial Transporters, Ltd.
British Graetzin Light, Ltd.
Eclipse Electric Sign Co., Ltd.
Electrical Works (Miller), Ltd.

Isle of Thanet Electric Tramways & Lighting Co., Ltd.—According to the *Financial Times*, the accounts for the year ended September 30th last show a loss of £4,731, which reduces the credit balance to be carried forward to £3,825.

STOCKS AND SHARES.

TUESDAY EVENING.

BUSINESS in the Stock Exchange has fallen away a good deal. Amongst the principal causes for the decline in animation are the excellent success of the Tank campaign, the news from Russia, the uncertainty surrounding affairs in Mexico, and a general inclination on the part of the public to keep money back until the next taxation proposals are unfolded. The truly perplexing condition of affairs in Russia is well likened to a vast cinematograph performance in the hands of inexperienced operators, and the latest move on the part of the Bolsheviks in attempting to commandeer British-owned mines in the north of Russia is a new cause for apprehension to those who have money invested in the industrial companies working in Petrograd and Moscow under the control of British hands. It may be recalled that some time ago there was a sensational rise in the price of certain Russian shares on account of a contract secured by one of the companies for the electric lighting in Petrograd, and, although this is now a matter of history, the latest developments in that chaotic country are enough to give rise to uneasiness amongst the British holders of shares in Russian companies.

The Metropolitan Railway Co. is due to declare its dividend this week, and the announcement should be out before the current issue of this journal. There had been a glimmer of hope that, under pressure of popular opinion, the home railway companies might increase their dividends in respect of the last half-year, and, although the Tube companies are not State-controlled in the same manner as the big trunk lines, anticipation was disposed to look for the Undergrounds to make an effort to fall into line with the rest if the latter raised their distributions. There is, however, little hope now that this course will be followed, and the Stock Exchange market looks for a repetition of the 1 per cent. on Metropolitan Consolidated stock paid a year ago, with the usual 2¾ per cent. on the Surplus Lands stock. The price of Surplus Lands stands at 47, which makes the yield, at 2¾ per cent., allowing for accrued dividend, 6 per cent. on the money, comparing with the 4½ per cent. afforded by the Consolidated stock, so that the former is decidedly the cheaper of the two, and only its lack of negotiability prevents it standing higher than the Ordinary stock does. The Underground group will declare their dividends on February 7th. The District Co. has paid nothing since August, 1882, 35½ years ago. The Income Bonds of the Underground Co. are expected to get 4 per cent., which is, of course, paid free of tax, and nothing is looked for on either class of the shares.

Mexicans have been checked in their upward movements by the usual cause which has brought them down after previous rises, namely, that definite information is lacking to support the rumours and hopes raised at the beginning of the year with reference to the re-establishment of normal conditions in the country. Nor is there much enterprise or speculation afoot to encourage optimism with regard to Mexico or anything else, and, although the prices of the various Utility bonds are maintained at their previous levels, it is not so easy to sell now as it was two or three weeks ago. The weakness of Canadian industrials, including those of the light and power companies, is still in evidence, and rumour has it that in some cases, where the concerns have accepted large munition contracts for Russia, difficulties have arisen in regard to their getting paid.

Brazilian Tractions have gone back to 46, a fall of a point, but the Anglo-Argentine group remains steady, and amongst other foreign issues there is no special feature outstanding. Shares of the Hydro-Electric Co. of Tasmania have come into new prominence, and on Monday touched the highest price so far attained during the present boomlet in the shares. After reaching 13s. 9d., the price eased off a little to 13s. 3d., having run up just lately from 8s. 6d., to which it reacted after the previous rise to 12s. 9d., the same reasons being operative in the present bout of buying as those with which we dealt when the shares first began their sensational ascent.

The electricity supply list is quietly firm. Attention is once more being called to the market, in various directions, as offering a good field for investment for money that looks for a 6 per cent. return with a reasonable degree of safety. The War Bonds campaign, however, is certainly telling on this department, as on other parts of the Stock Exchange, and we find a decided disposition, on the part of people with money, to put it into the War Bonds, and to take the 5½ per cent. which these offer. Both the Adelaide and Melbourne Supply Companies announce excellent results and dividends for the year just ended.

Deductions of the dividends from several of the shares in the Eastern Telegraph group have made comparatively little difference in prices. Globe Ordinary are ¼ better at 14¼. Indo-Europeans reacted £1 to 51½, and Anglo-American Preferred is ¼ lower at 94½, the market in this stock having been a dull one for some time past. Manufacturing shares are good, with rises of ¼ in Callenders and of ½ in India-Rubber shares. The iron and steel market is a little easier, Babcocks receding to 3¼. Chemical shares are firm throughout, more particularly those in companies dealing with soda and the like. There is no change in Castner-Kellners at 3 5/16. The rubber market is dull and heavy, several disappointing dividends conspiring with a further reduction in the price of raw material to bring about a weak tendency in prices. The base-metal markets, however, are hard, more particularly for the shares in companies concerned with lead, tin, and zinc. Armaments exhibit a dullish tendency, although ammunition shares are better on the week.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price Jan. 22, 1918.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	9	6¼	—	£6 18 6
Charing Cross Ordinary ..	5	5	4	—	6 5 0
do. do. do. 4½ Pref..	4½	4½	3⅝	—	6 18 4
Chelsea	4	3	2⅝	—	5 9 1
City of London	8	8	13⅛	—	6 0 9
do. do. 6 per cent. Pref.	6	6	10⅜	—	5 18 6
County of London	7	7	11	—	6 7 3
do. 6 per cent. Pref.	6	6	10⅜	—	5 18 6
Kensington Ordinary	7	6	6⅝	—	5 11 7
London Electric	3	Nil	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3½	—	5 6 8
Metropolitan	3	3	3½	—	4 12 4
do. 4½ per cent. Pref.	4½	4½	3½	—	6 13 4
St. James' and Pall Mall ..	5	5	7	—	5 14 6
South London	3	3	3	—	6 13 4
South Metropolitan Pref. ..	7	7	21/8	—	6 10 8
Westminster Ordinary	7	7	6⅜	—	5 5 8
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	94½	— ½	6 7 0
do. Def.	33/8	1½	23⅜	—	6 8 4
Chile Telephone	5	5	7½xd	—	5 13 4
Cuba Sub. Ord.	5	7	9½	—	*7 11 4
Eastern Extension	8	8	15xd	—	*5 6 0
Eastern Tel. Ord.	8	8	150½xd	—	*5 6 4
Globe Tel. and T. Ord.	7	7	14¼	+ ¼	*4 19 1
do. Pref.	6	6	10⅜	—	5 17 1
Great Northern Tel.	22	24	90	—	6 11 6
Indo-European	13	13	51½	— 1	6 6 8
Marconi	10	15	3½	—	4 16 1
Oriental Telephone Ord. ..	10	10	3½	—	3 4 0
United R. Plate Tel.	8	8	8½	—	*5 14 6
West India and Pan.	6d.	6d.	1⅛	—	*3 9 6
Western Telegraph	7	8	15½	—	*5 5 0
HOME RAILS.					
Central London, Ord. Assented	4	4	83½	—	6 8 0
Metropolitan	1	1	28½	—	4 5 1
do. District	Nil	Nil	15⅜	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	—	Nil
do. do. "A" ..	Nil	Nil	5/8	—	Nil
do. do. Income	5	4	82	—	*4 17 7
FOREIGN TRAMS, &c.					
	Dividend 1915.	Dividend 1916			
Adelaide Sup. 6 per cent. Pref.	6	6	4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	5½	2⅛	—	—
do. 2nd Pref. ..	5½	—	2⅜	—	—
do. 5 Deb. ..	5	5	68	—	7 11 6
Brazil Tractions	4	4	46	—	—
Bombay Electric Pref.	5	5	98	—	5 1 4
British Columbia Elec. Ry. Pfce.	5	5	43	—	11 12 4
do. do. Preferred	Nil	Nil	28½	—	Nil
do. do. Deferred	Nil	Nil	28	—	Nil
do. do. Deb.	4½	4½	68	—	7 6 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	—	Nil
do. 6 per cent. Bonds	Nil	Nil	34½	—	Nil
Mexican Light Common ..	Nil	Nil	17½	—	Nil
do. Pref.	Nil	Nil	29	—	Nil
do. 1st Bonds ..	Nil	Nil	57	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3¼	— 1/16	4 12 4
British Aluminium Ord. ..	7	10	1⅞	—	6 9 9
British Insulated Ord.	17½	20	8½	—	6 8 2
British Westinghouse Pref. ..	7½	7½	2⅜	—	3 14 4
Callenders	20	20	14¾	+ ¼	6 15 7
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	20	3 5/16	—	6 1 3
Edison Swan, fully paid ..	—	—	2⅛	—	Nil
do. do. 4 per cent. Deb.	4	4	75½	—	5 6 0
Electric Construction	7½	7½	1⅝	—	6 18 4
Gen. Elec. Pref.	5	5	10⅜	—	5 15 8
do. Ord.	10	10	19	—	5 5 3
Henley	25	25	16½	—	7 11 5
do. 4½ Pref.	4½	4½	4	—	5 12 2
India-Rubber	10	10	14¾	+ ½	*6 15 7
Telegraph Con.	20	20	42	—	*5 14 3

* Dividends paid free of income-tax.

INDUSTRIAL RESEARCH.

BY G. BASIL BARHAM.

ELECTRICAL engineers generally are convinced that the commercial position of Britain after the war will depend to a great extent on the energy with which she takes up the work of industrial research. It seems certain that the electrical and, indeed, the engineering supremacy of the future will belong to that country which conducts such work vigorously and in a well organised manner, improves the products of its workshops by the knowledge thus gained, and maintains its lead over all competitors by the simple means of continually improving the quality, increasing the quantity, and bettering the efficiency of its electrical and other manufactures.

Good work will undoubtedly be done by the Department for Scientific and Industrial Research, but its efforts will be insufficient to enable this country to keep the lead in electrical matters unless it is backed up by every firm, both large and small, that is engaged in the industry. The proposal is that Research Associations should be formed in various districts, but as the proposal stands at present provision is made for only science, capital, and manufacturer to be represented. But in such a matter success is not possible unless Labour is also included, and by that is meant unskilled as well as skilled labour. Further, the co-operation of shipbuilders, colliery owners, and manufacturers generally is necessary, and the efforts of any Association, no matter how strong it may seem on paper, are doomed to failure unless research laboratories, as completely equipped as possible, are fitted up wherever manufacturing work is carried out on a fairly extensive scale. It is further necessary that representatives of the electrical industry should have access to these, and should assist in the work carried on, in order to determine to what extent electricity can be of assistance either for driving, electrolytic or thermo-electric purposes.

In the United States it is now the custom in the materials testing laboratories, in the standardising laboratories, in the departments which are interested in the testing of apparatus of different kinds, and in the development departments of the bigger manufacturing concerns, to allow research work to be carried on, and not only to encourage it, but to fit up laboratories and workshops for those who, showing promise, are desirous of carrying out independent investigations. By this is meant that in some of these works a youth or man who has shown himself possessed of keen intelligence, is allowed in the firm's time to attempt to discover new methods of working or to improve those already in vogue. This should also be done in this country, with this addition: that a higly trained electrical engineer should be retained to assist in every way possible the efforts of those who were engaged in the research. Many an industrial method could be simplified, many an investigation hastened and brought to a more successful conclusion were this course adopted.

It is almost common knowledge now that an entirely new branch of chemistry, the chemistry of the free atom, resulted recently from the exhaustive research work carried out in the chemical laboratory of a large electrical engineering firm, and the importance of this discovery, from a commercial point of view, cannot well be over-estimated. The invention of many new manufacturing processes has taken place in a number of trans-Atlantic research laboratories, and already in the United States the chemical engineer has become a recognised member of the engineering profession, solely through the establishment of research laboratories, although he is practically unknown over here.

Just as is the chemical engineer so is the electrical engineer destined to play a most important part in the development of every country's resources. Theirs will be the task of watching the laboratory experimentalist, of studying laboratory processes, with a view to devising stills, retorts, electric furnaces, machinery and everything necessary to carry out the discovered processes and methods on a commercial scale. Should a chemist succeed in making a few drops of some new dye, it will be the duty of the chemical engineer to devise apparatus that will manufacture it by the hundred gallons; should a new alloy of steel with nickel, tungsten, chromium, molybdenum or other rare metal be discovered, the electrical engineer will find his work in devising a furnace that will be able to turn it out on such a scale that the steel-making supremacy of his country will be maintained against all competitors. Further, should some hitherto unsuspected property be found in a metal or an alloy, it will be the duty of both to devise some means whereby it can be turned to commercial advantage.

Perhaps one of the most important results which would be obtained from the extension of a system of technically assisted industrial research would be the training of men as skilled investigators. Results are seldom or never secured, as has been said before, by casual workers in the field or by those who engage in scientific work through the sheer love of science. The question what commercial use can be made of a discovery should always be before the eyes of a research worker. Unfortunately that is not always possible as matters stand, as the discoverer may have but the slightest notion of the value of his achievement. It is in such event that trained assistance, such trained assistance as can only be given by the chemical and electrical engineer, becomes necessary. The experimentalist, as a rule, makes it his whole business to find out hitherto unsuspected laws of Nature, and simplify them, and increase our knowledge and understanding. This is a work to which, as one who has had long and profitable experience of it once said, those who engage in it must pay undivided attention; it is for the technically trained man to take the results and turn them to an industrial end. Otherwise we shall find that the men engaged in our research laboratories will be investigators first and all the time; they will be men who will fight their way along the path of knowledge, seeking only what lies before them and taking little or no heed of what they have done as they passed along. Condensed into its least compass, the final object of industrial research work is to enable us to use the resources of Nature to better purpose to-morrow than we can do to-day, and that is only possible if we provide the man who is carrying out the work with trained assistance, to turn his results to the best advantage.

ELECTRICAL COOKING AS APPLIED TO LARGE KITCHENS.

ON January 14th the NEWCASTLE-UPON-TYNE LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS discussed Mr. W. A. GILLOTT's paper.

The Chairman, Mr. A. H. MARSHALL, in opening the discussion, said economy in cooking was, at the present time, of vital importance, even more important than fuel economy. When engineers looked into that question they generally had regard to the quantity, or the cost, of the fuel used in cooking by gas or coal-fire, or the amount of fuel it took to generate the amount of electricity used, and then left the cooking alone; but there were many considerations that modified comparisons of that kind—for instance, that of thermal efficiency—and this was rapidly increasing in the case of electricity.

Mr. PINKNEY said he thought the subject was not receiving the attention it ought to have had. The question of large cooking installations was one for the engineers. Referring to the maintenance figures, he said that, apart from the character of the installation, maintenance costs would go down, due to better handling by the users. The cooking question would have to be met by the supply authorities—that was, the question of large kitchens, for the question of domestic cooking was a different problem altogether. One great point in electric cooking was that there was no chimney, and, consequently, no loss of heat in that way. A great many pessimists had said that electric cooking could not be done cheaply; it had been done cheaply, in spite of everything.

Mr. W. SOWERBY said he was not an electrician, and he spoke on the subject merely as a business man. His firm, proprietors of cafés, asked him to take out the costs of different modes of cooking—coal, gas, and electric; he had to go thoroughly into the matter, and report. They knew approximately the cost of cooking by gas and by coal, and then he applied to the Newcastle Electric Supply Co. He said: "We are going to provide so many persons with so many meals; can you tell us what it will cost us per meal to do the work by electricity?" The company made an estimate and submitted it. His company were astonished; indeed, they thought a mistake had been made, but the Supply Co. confirmed their statement, and said they were prepared to go on with the work. The work was carried out, and he might say that after a period of 12 months their costs were

considerably below those furnished in the estimate. When they put in the apparatus their friends said, "Ah, wait until you get the bill"; they had got the bill, and they were quite satisfied. The installation was not fool-proof, and needed care. He particularly spoke of the saving by the use of the calorifier in the heating of the water. He believed a good deal of their success was due to the fact that they charted their consumption, and, if the figures were excessive, raised the question with their employés.

Mr. C. TURNBULL said he agreed both with the lecturer and the speakers that there was a great future before electrical cooking. He thought one reason why they were not going ahead was that the manufacturer did not appreciate the necessity of making everything easy of repair; everything should be made so that it would be easy to get at any part. He should not be surprised, if the amount of cooking increased, if it assisted in bringing about the downfall of D.C., and made alternating current general, for cooking with A.C. had many advantages.

Mr. GILLOTT, replying, said he agreed with the speakers that electric cooking was bound to extend. Three or four years ago he suggested to an electrical company that cooking was going to oust from its position their small power load; the suggestion was met with a smile, but, as a matter of fact, they had passed it, and he thought that in 10 or 15 years' time electrical cooking would be one of the biggest sides of electrical undertakings. Mention had been made of thermal efficiency; it reminded him of a gas representative who said he could give a customer 9,000 B.TH.U. for 1d., and that the electric companies could not give 5,000. He was asked what was the efficiency. He could not say. "Would it be 50 per cent.?" The gas man thought that would be high. Yet their electrical efficiency was 95 per cent. But running cost was not the most important item; there were so many advantages to be obtained in other directions that cooking by electricity would be cheaper at ¾d. per unit than if they got gas for nothing. It was a bold statement, but he was prepared to prove it.

A CONSTANT-TORQUE MAGNETIC CLUTCH.

The device described below consists of a differential electromagnetic clutch or coupling, which may be used to connect an electric motor, or other prime mover, to a dynamo, or to connect an electric motor to a mechanical load. It has been patented by Messrs. WALTER L. DAVIES and ALFRED SOAMES for controlling (*a*) the electrical output of a dynamo, (*b*) the mechanical output of a motor.

Fig. 1 shows it employed in driving a dynamo supplying current to an arc welding outfit at Faraday House, and fig. 2 is a diagram showing the basic principle upon which it operates.

In this clutch there are three coils, A, B, and C; A and C consist of many turns of fine wire, and B is a series coil consisting of a few turns of thick wire. No part of the clutch moves longitudinally; thus its reluctance remains constant, and the variation of the magnetism produced by the coils varies the pressure between the clutch members only.

The action of the clutch is as follows:—Coil A is energised either from the mains or from a small exciter on the *driving* shaft, and produces an initial pressure between the clutch members which is more than sufficient to transmit the load. Coil B is connected in series with the dynamo armature, and its polarity is such as to counteract the pressure produced by the coil A.

It will be seen that as the current in coil B increases, *i.e.*, as the load is increased, the pressure between the clutch members *decreases*, until a point is reached when the pressure on the clutch is only just sufficient to transmit the load without slipping; past this point, the clutch slips. It is

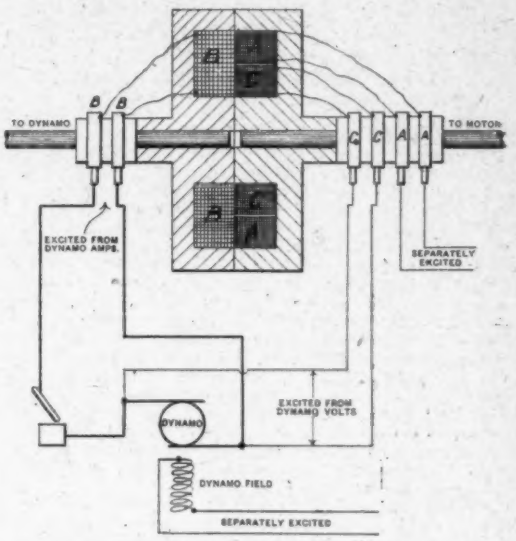

FIG. 2.—DIAGRAM OF CIRCUITS.

apparent, therefore, that the current taken from the dynamo cannot exceed a given maximum, even if it is short-circuited. The particular maximum to be reached can be controlled by adjusting the excitation of the coil A with a rheostat.

In the case of a simple electromagnetic clutch with constant excitation, the coefficient of friction drops rapidly when slip commences to take place, and therefore, if the pressure remains constant, the clutch will slip to about half-speed if called upon to give a constant torque (corresponding, in this case, to constant current in the dynamo circuit). To counteract this variation in the coefficient of friction, coil C has been added; this coil is connected across the brushes of the dynamo, and its polarity is opposite to that of coil A.

The effect of these three coils is as follows:—On open circuit coil A gives an initial pressure; coil C, which is across the dynamo brushes, reduces the pressure produced by A. If current is now taken, the coil B still further reduces the pressure, until a point is reached when the clutch slips, but when the clutch slips the volts of the dynamo decrease; this decreases the effect of C, which is equivalent to increasing the effect of A, and by this means the slip is prevented from unduly increasing. Should the current taken from the dynamo tend to increase, the action of the series coil B would decrease the pressure, and, as a result, the coils B and C adjust the pressure so that the current remains practically constant.

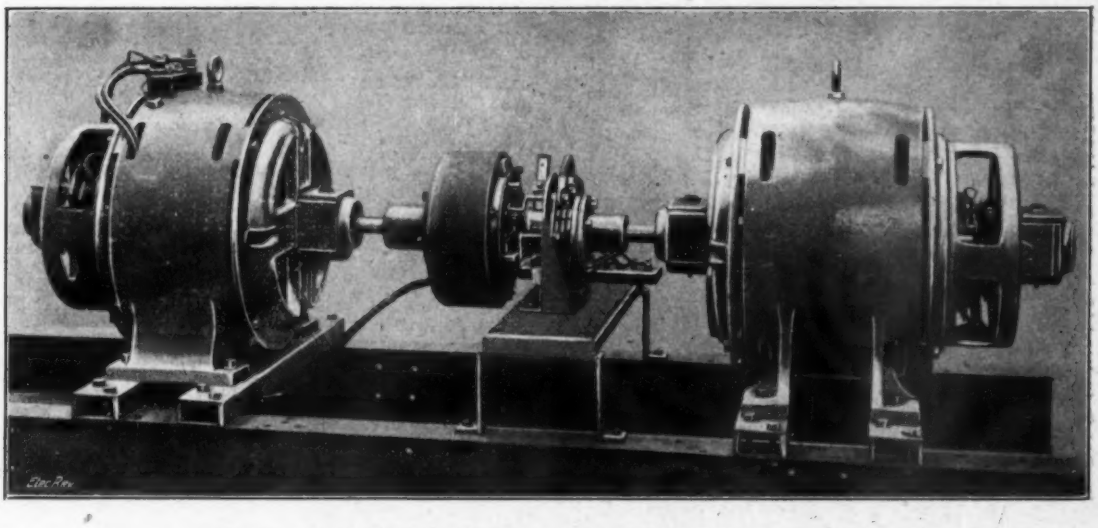

FIG. 1.—MOTOR DRIVING GENERATOR THROUGH ELECTRO IAGNETIC CLUTCH.

Since the dynamo is separately excited, its field remains constant, and (owing to the clutch) the armature field is practically constant at all speeds, therefore there is no sparking at any speed, and the dynamo can be instantly short-circuited from open circuit without any harmful result. By suitably proportioning the coils A and C, any desired characteristic may be obtained.

Since this clutch acts not only as a current regulator, but as a kind of mechanical overload release, readjusting itself when the overload is removed, its applications are very wide; three of these may be indicated, namely, electric arc welding, battery charging, and as a coupling in motor-generator sets, especially those used for tramway supply.

The advantages of this arrangement for electric arc welding are as follows:—

Any dynamo giving sufficient power may be used, and be driven from any suitable source of power, its characteristic being so altered as to make it suitable for the work.

The maximum current to be taken can be set at any value within the limits of the dynamo rating.

When the desired current has been set, it remains practically constant from short-circuit to the maximum length of arc that the volts will maintain; there is no necessity to snatch at the arc when striking it, the electrodes can be rubbed together, and the arc drawn out as desired. A short arc does not produce a rise of current and consequent burning; the operator is thus enabled to give his full attention to the work, as the arc cannot run away from him.

There is no resistance whatever introduced into the welding circuit, consequently *the whole of the watts generated are used upon the work*; this not only reduces the operating cost, but substantially increases the plant efficiency.

Since the clutch only slips on an overload, the power lost by it when running is entirely negligible.

For controlling the mechanical output of a motor, a similar clutch wound with the three coils A, B, and C is used, but in this case the B, or series coil, is in series with the motor armature, and its action is to make the clutch slip when the motor takes the maximum current it is to be allowed. A very small dynamo is attached in any convenient position to the variable-speed side of the clutch, so that its volts will vary with the speed; this dynamo energises the C coil, and compensates for the variations of friction as previously explained.

The clutch is obviously suitable for driving any class of machinery subject to sudden shocks, or to very intermittent

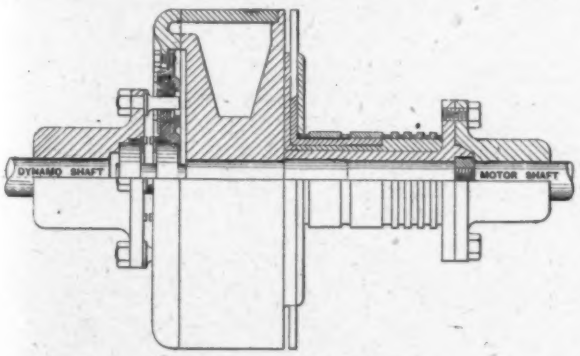

FIG. 3.—SECTION OF CLUTCH.

loading, such as rolling mills, stamping presses, heavy lathes and planing machines, shears, &c. It gives complete protection to machinery likely to be jammed, such as anchor winches, capstans, and winding drums for hauling trucks in mines.

The device can also be arranged as a hand-operated magnetic friction clutch. The chief difficulty met with in designing electromagnetic friction clutches of this type is due to the residual magnetism, which prevents the clutch releasing when the current is reduced or switched off.

In the clutch under consideration, the magnetic circuit has been made as compact as possible, so much so that it will transmit 1,000 watts of electrical power with a consumption of less than 1 watt, *i.e.*, 1/10th per cent. loss. The residual magnetism of this clutch is over 50 per cent., but owing to the special method of operating it, this residual magnetism is completely swept out, on releasing the clutch, and it can be operated at any degree of slip and any load *gradually* upwards and downwards between zero and full load.

In consequence of the excellence of the magnetic circuit, if desired this clutch may be arranged to be magnetised to a higher density than that required to transmit the load, in which case the current can be cut off altogether when the clutch is transmitting full load, the residual magnetism being sufficient to carry the load, and the clutch works without any consumption of energy at all, the current being only employed to pick up or release the load.

The clutch itself is simply a well-designed electromagnet, wound with a single magnetising coil, connected to one or two slip-rings, and connected to the circuit as follows:—

In fig. 4 A is a small battery, or other source from which a small current may be obtained. This battery is connected to the opposite sides of a continuous resistance R, R, R, R. Two brushes B,B, are arranged to slide round this, and the ends of the clutch coil C are connected to these brushes.

It is obvious that if the brushes are in the position x′ x the clutch receives its maximum current; if they are slid round in the direction of Y′ Y, the current decreases to zero at Y′ Y, and if they are slid on in the same direction to some such position as z′ z, the current in the clutch reverses and rises in the opposite direction.

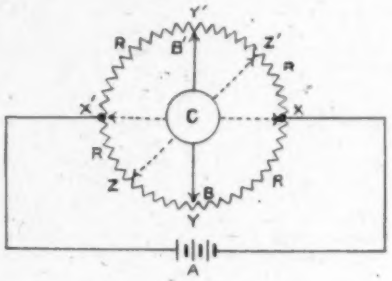

FIG. 4.

To release the clutch from full load, the brushes are slid round from x′ x in the direction of z′ z until the current is reversed, and rises sufficiently in the opposite direction to sweep out all the residual magnetism.

Stops are placed at x′ x and z′ z; the clutch can then be worked with a perfect gradation of slip between these points.

In the clutch shown the power consumption over the clutch coil and the resistance R, R, R, R amounts to about 2 watts per 1,000 watts transmitted.

We recently visited Faraday House, and had the pleasure of seeing the foregoing features fully demonstrated by Mr. Davies. We may point out that the clutch is not intended to slip continuously, after the style of a slipping-belt drive, though it could do so if necessary without overheating. Even on so erratic a load as arc welding, with the arc purposely handled in the jerkiest manner, the clutch maintained a practically constant current, and in all respects substantiated the inventors' claims on its behalf.

GAS FIRING BOILERS.

Mr. T. M. HUNTER's paper was read before the YORKSHIRE LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS on January 15th.

Mr. W. LANG (Chairman) said the subject was one that interested practically the whole of the country at the present day.

Mr. C. N. HEFFORD (Leeds) said he gathered that the paper was designed for the assistance of engineers who were connected with coke-oven processes, or ironworks where waste gas existed. He did not draw any information from the paper which would encourage one to go in for steam-raising from gas-fired boilers where one had to consider the obtaining of gas purely for that purpose. A continuation of Mr. Hunter's paper showing how an expert would deal with the problem of generating 2,000,000,000 lb. of steam per annum from gas-fired boilers, and information as to what capital charges would be necessary, would be useful. Such a steam-raising plant could not be accommodated in any large centre of industry, but would need to be adjacent to some colliery. There would have to be an enormous economy in generating electricity if the removal of central stations from towns was going to be justified.

Mr. HARRIS remarked that it would be absolutely out of the question for steam users in manufacturing towns to make use of gas for such purposes. What interested them most was what use could be made of producer gas in towns for steam raising. He knew quite a number of places that put down gas plant years ago, but he could not think of one that was now in existence. If the power at an electric light station was got from gas firing the plant would have to be very large. He desired to know if there was any first-class installation of boilers fired with producer gas. Collieries used to have large quantities of refuse fuel such as shale, coal dust, and numerous other things which they threw away. Many of them were now using that refuse, and getting just as good evaporation from their boilers through the use of modern appliances as they previously got with ordinary hand stoking.

Mr. WILSON HARTNELL (Leeds) considered that if consumers could get waste gases from a coke oven they might use them with advantage, but he did not think that could be done in Leeds.

Mr. W. HOWARD BROWN (Bradford) recalled experiments made a few years ago with gas from some blast furnaces which proved failures. The gas appeared to be all right, but

there was very little heat in it, and the consequence was that before the full load was reached a considerable use of coal had to be made to keep the steam pressure up. The question of gas firing for boilers was probably not so important in Yorkshire as it was in the South of England. It would be well if the lecturer could, at some time, give them another paper which would deal more with the practice of burning producer gas.

Mr. A. TERRY (Leeds) wished to know whether, in view of the proposals made by the recent Committee on Electrical Supply, the author of the paper proposed that the installation should be situated close to the coal mines, and the coal be first used in by-product ovens.

Mr. J. SHEPHERD (Leeds) observed that the paper was extremely interesting, but was disappointing in one way because if left untouched the great problem, which was: "Where power is needed, what is the best way to get it?"

Mr. T. M. HUNTER, in replying on the discussion, said with regard to transmission, the transmission of electricity was a very expensive matter, whilst the transmission of gas was a very cheap matter, and the losses on transmission of gas were very small. The American figures for loss in transmission were from .5 per cent. up to about 2 per cent., and gas there was sometimes transmitted for 100 miles or so. Gas was transmitted under high pressure. If gas could be generated outside the towns and transmitted in pipes to the existing power stations, those stations would be used very economically, and they could generate electricity without increasing the capital charges. To blast-furnace proprietors, gas at the present time was a very valuable product. They could not hope that a gas producer plant could take peak loads for steam-raising purposes. They could never press a producer plant. Some other method for taking peak loads would have to be resorted to. The provision of superheated air was very important with regard to gas firing, as it was with coal firing. On the Continent they were far ahead of us in this matter. The installation of the Yorkshire Waste Heat Co. had been very successful.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

GRENADA.—The Board of Trade have received information that the recent Proclamation prohibiting the importation of electrical apparatus and other articles—noted in the ELECTRICAL REVIEW for September 7th—has been revoked.

RUSSIA.—By a Customs Circular dated August 3rd/16th, the Minister of Finance has sanctioned the following interpretation of the Customs Tariff as regards electric fuses:—

Electric fuses complete, with interchangeable working parts, in the composition of which there is usually silver in the form of connecting wire, forming a very inconsiderable part of the weight of the fuse, are to be admitted under Section 169, point 1 (the duty thereunder is 13 roubles 20 copecks per poud). Separately imported working parts of electric fuses made of common materials, with wire of low-proof silver (below 84 proof) are to be admitted under Section 169, point 1, in accordance with the Note to points 1 and 2 of this Section; and similar working parts of fuses, with wire of high-proof silver, under Section 148, point 4, as manufactures of silver (the duty being 9 roubles 90 copecks per funt).

[Poud = 36.114 lb. avoirdupois; funt = 14.45 oz.; rouble (100 copecks) = 2s. 1½d. (par rate).]

ITALY.—The revision of the Italian Tariff has reached a further stage by the publication of a law appointing a Parliamentary Commission for the examination of the new draft Customs Tariff which the Government is to draw up and submit for legislative sanction. The Commission is to consist of 15 Deputies and 15 Senators of the Italian Parliament. The proposals of the Royal Commission appointed to study the question are to form the basis of the new Tariff.

In regard to the existing Italian import prohibitions, it should be noted that it is necessary for importers to obtain licences for the import of British goods, with the exception of certain foodstuffs, raw materials, chemicals, &c. At present, applications for such licences must be submitted by the would-be importers to the competent authorities, through the medium of Italian Chambers of Commerce.

UNITED STATES.—Full details of the American export prohibitions are now available. As was to be expected, the list of prohibited goods is very comprehensive, and includes, *inter alia*, all engines and motors worked by electricity, all electrical equipment, metals, and wireless apparatus and accessories.

Applications for export licences must be made by the exporter to the Exports Administrative Board at Washington, or 11, Broadway, New York. They will be valid for 60 days, unless previously revoked. Licences for certain articles will only be issued if such articles are destined for actual war purposes, or for purposes directly contributing thereto. The prohibitions affect goods in transit through the United States, as well as domestic products. For consignments not exceeding 100 dols. in value, export licences may be granted under special declarations.

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electric Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

336. "Ignition magnetos for internal-combustion engines." A. F. MARCH. January 7th.

354. "Railway signalling." MCKENZIE, HOLLAND, & WESTINGHOUSE POWER SIGNAL CO. (Union Switch & Signal Co., U.S.A.) January 7th.

363. "Apparatus for measuring want of equilibrium in galvanometer coil, &c." J. RYMER-JONES. January 7th.

379. "Telegraphic apparatus." E. A. WILLSON. January 7th.

386. "Electrically-propelled vessels." F. LJUNGSTROM. January 7th.

395. "Sparking plugs, &c." G. H. WARD. January 8th.

404. "Means for attaching mouthpieces of telephones, speaking tubes, &c." TAYLOR, TUNNICLIFF & CO. AND E. D. M. SCRIVENER. January 8th.

411. "Electron-emitting cathodes, and process of making same." WESTERN ELECTRIC CO. (Western Electric Co., U.S.A.) January 8th.

420. "Electrodes for electric welding." QUASI-ARC CO. & A. P. STROHMENGER. January 8th.

422. "Electric lampholders." J. H. COLLINGS & M. J. RAILING. January 8th.

423. "Electric guns." L. M. BOWMAN & W. A. SMITH. January 8th. (U.S.A., May 29th, 1917.)

431. "Overhead system of electric traction." A. OROM. January 8th.

436. "Electric wall plugs, &c." J. R. CRAIG. January 8th.

458. "Sparking plugs for internal-combustion engines." R. TAYLOR. January 8th.

474. "Incandescent electric lamps for projection purposes." D. LELY AND NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPENFABRIEKEN. January 8th. (Holland, June 2nd, 1917.)

478. "Transformation of polyphase into practically constant direct currents." O. M. CORBINO. January 8th. (Italy, January 8th, 1916.)

480. "Telephone systems." AUTOMATIC TELEPHONE MANUFACTURING CO. (Automatic Electric Co., U.S.A.) January 8th.

523. "Receiving radio-signals." MARCONI WIRELESS TELEGRAPH CO. January 9th. (U.S.A., July 19th, 1917.)

534. "Sign telegraphs, &c., electric advertising devices." H. K. HARRIS. January 9th.

545. "Winding with equipotential connections for drum armatures of electric commutator machines." E. C. R. MARKS (Akt. Ges. Brown, Boveri et Cie.). January 9th.

551. "Manufacture of carbon electrodes." B. E. D. KILBURN (Norsk Aktieselskab for Elektrokemisk Industri). January 9th.

555. "Audion or lamp relay or amplifying apparatus." M. LATOUR. January 9th. (France, January 9th, 1917.)

557. "Silencing pads for telephone or speaking-tube ear pieces and ear stoppers." A. C. BROWN. January 9th.

561. "Electric switches." A. H. F. PERL. January 9th.

574. "Electric switches." G. O. DONOVAN & W. DONOVAN. January 10th.

579. "Electric air purifier and destructor." W. J. CALDER. January 10th.

587. "Magnetic separators." H. CORNELL. January 10th. (Australia, January 12th, 1917.)

590. "Signalling device for aircraft." H. EBURY. January 10th.

600. "Manufacture of electric cables." C. J. BEAVER & E. A. CLAREMONT. January 10th

609. "Galvanometers for measuring-instruments." CAMBRIDGE SCIENTIFIC INSTRUMENT CO. & E. C. HURST. January 10th.

615/6/7. "Electric starting apparatus for motor vehicle engines." H. LUCAS & C. L. BREEDEN. January 10th.

662. "Electric replaceable fuses." M. H. GOLDSTONE. January 11th.

673. "Ventilating devices for electrical machinery, &c." SIEMENS SCHUCKERTWERKE. January 11th. (Germany, December 22nd, 1916.)

676. "Wireless signalling systems." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.) January 11th.

684. "Circuit arrangements for operating selecting devices of telephone installations by number impulses." T. PETTIGREW. January 11th.

704. "Machine switching telephone systems." L. POLINKOWSKY & WESTERN ELECTRIC CO. January 11th.

723. "Power generating devices." J. PETERSON. January 12th.

729. "Electrode holder for electric furnaces." J. E. ROBINSON & C. W. KAYSER. January 12th.

738. "Sparking plugs." D. COLLINS. January 12th.

754 "Magneto-electric machines." L. G. CAUNTER & F. W. SUTER. January 12th.

757. "Electric transformers, &c." A. SCHAANNING. January 12th.

760. "Sparking plugs for internal-combustion engines." W. D. BRAND. January 12th

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

17,934. ARRANGEMENTS FOR ADVANCING THE IGNITION IN INTERNAL-COMBUSTION ENGINES. Soc. Anon. pour l'Eclairage Electrique des Vehicules. December 20th, 1915. (102,951.)

18,144. MAGNETOS WITH FIXED ARMATURES. E. C. R. Marks (Soc. Anon. des Etablissements L. Bleirot). December 18th, 1916. (112,038.)

1917.

436. INDUCTION COILS OR TRANSFORMERS. M. A. Codd. January 9th, 1917. (112,051.)

713. ELECTRIC LAMPS FOR MOTOR VEHICLES AND FOR OTHER PURPOSES. C. F. L. King. January 15th, 1917. (112,055.)

2,340. PROCESS FOR JOINING UP ELECTRIC AND OTHER WIRES. J. H. van Viersen, and Slot & Zwijnenberg. September 2nd, 1916. (109,432.)

7,606. CORES FOR PUPIN LOADING COILS, MAGNETS AND THE LIKE. Western Electric Co. May 26th, 1916. (107,007.)

8,598. X-RAY TUBES. W. J. Robinson. June 15th, 1917. (112,101.)

8,726. DEVICE APPLICABLE TO THE SPRING-CONTROLLED SWITCHES OF TELEPHONE RECEIVERS. A. S. John. June 18th, 1917. (112,103.)

8,949. DIAPHRAGM VIBRATORS OR SOUNDERS. H. S. A. Rydberg. June 30th, 1916. (108,305.)

14,981. CONTINUOUS-CURRENT DYNAMOS. F. Kesellring. June 8th, 1916. (Divided application on 8,150/16.) (112,116.)